
I-10 EAST CORRIDOR PROFILE STUDY

STATE ROUTE 202L (SANTAN FREEWAY) TO NEW MEXICO STATE LINE

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Draft Working Paper 4: Performance-Based Needs Assessment

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APPENDICES

Appendix A: Methodologies for Determining Performance Area Needs (Steps 1-3)

LIST OF ABBREVIATIONS

ABBREVIATION	NAME		
10B	I-10 Business Route	TPTI	Truck Planning Time Index
ADOT	Arizona Department of Transportation	TTTI	Truck Travel Time Index
AZTDM	Arizona Travel Demand Model	UP	Underpass
DMS	Dynamic Message Sign	V/C	Volume-to-Capacity
EB	Eastbound	WB	Westbound
FY	Fiscal Year		
HSM	Highway Safety Manual		
I	Interstate		
L	Loop		
LOS	Level of Service		
MAG	Maricopa Association of Governments		
MP	Milepost		
MPD	Multimodal Planning Division		
N/A	Not Applicable		
NB	Northbound		
OP	Overpass		
P2P	Planning to Programming		
PAG	Pima Association of Governments		
PDI	Pavement Distress Index		
PeCOS	Performance Evaluation Cost System		
POE	Port of Entry		
PSR	Pavement Serviceability Rating		
PTI	Planning Time Index		
SB	Southbound		
SCMPO	Sun Corridor Metropolitan Planning Organization		
SEAGO	South East Arizona Government Organization		
SHSP	Strategic Highway Safety Plan		
SR	State Route		
TI	Traffic Interchange		

1.0 INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study of Interstate 10 (I-10) between State Route (SR) 202L (Santan Freeway) and the New Mexico State Line (I-10 East). This study will look at key performance measures relative to the I-10 East corridor, and the results of this performance evaluation will be used to identify potential strategic improvements.

The intent of the corridor profile program, and of the Planning to Programming (P2P) process, is to conduct performance-based planning to identify areas of need and make the most efficient use of available funding to provide an efficient transportation network. ADOT is conducting 11 corridor profile studies. The 11 corridors are being evaluated within three separate groupings.

The first three studies (Round 1) began in spring 2014, and include:

- I-17: SR 101L to I-40
- I-19: Mexico International Border to I-10
- I-40: California State Line to I-17

The second round (Round 2) of studies, initiated in spring 2015, includes:

- I-8: California State Line to I-10
- I-40: I-17 to the New Mexico State Line
- SR 95: I-8 to I-40

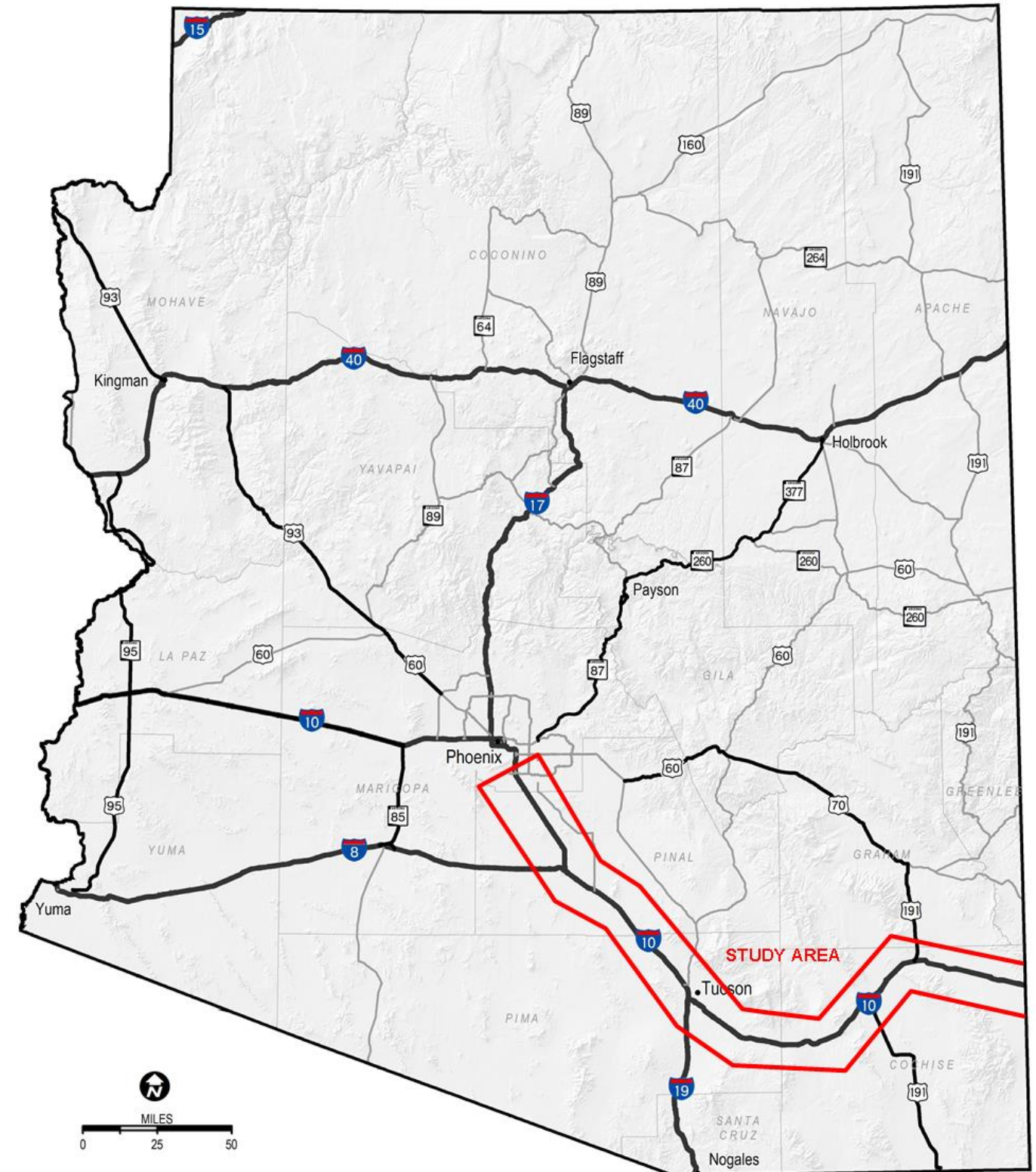
The third round (Round 3) of studies, initiated in fall 2015, includes:

- I-10: California State Line to SR 85 and SR 85: I-10 to I-8
- I-10: SR 202L to the New Mexico State Line
- SR 87/SR 260/SR 377: SR 202L to I-40
- US 60/US 70: SR 79 to US 191 and US 191: US 70 to SR 80
- US 93/US 60: Nevada State Line to SR 303L

The studies under this program will assess the overall health, or performance, of the state's strategic highways. The Corridor Profile Studies will identify candidate projects for consideration in the Multimodal Planning Division's (MPD) P2P project prioritization process, providing information to guide corridor-specific project selection and programming decisions.

I-10 East, SR 202L to the New Mexico State Line, depicted in **Figure 1**, is one of the strategic statewide corridors identified and is the subject of this Round 3 Corridor Profile Study.

Figure 1: Study Area



1.1 Corridor Study Purpose

The purpose of the I-10 East Corridor Profile Study is to measure corridor performance to inform the development of strategic solutions that are cost-effective and account for potential risks. This purpose can be accomplished by following the process established by the previous Round 1 corridor profile studies to:

- Inventory past improvement recommendations.
- Define corridor goals and objectives.
- Assess existing performance based on quantifiable performance measures.
- Propose various solutions to improve corridor performance.
- Identify specific projects that can provide quantifiable benefits relative to the performance measures.
- Prioritize projects for future implementation.

1.2 Corridor Study Goals and Objectives

The objective of this study is to identify a recommended set of prioritized potential solutions for consideration in future construction programs, derived from a transparent, defensible, logical, and replicable process. The I-10 East Corridor Profile Study will define solutions and improvements for the corridor that can be evaluated and ranked to determine which investments offer the greatest benefit to the corridor in terms of enhancing performance.

The following goals have been identified as the desired outcome of this study:

- Link project decision-making and investments on key corridors to strategic goals.
- Develop solutions that address identified corridor needs based on measured performance.
- Prioritize improvements that cost-effectively preserve, modernize, and expand transportation infrastructure.

1.3 Working Paper 4 Overview

The purpose of Working Paper 4 is to document the performance-based needs for the I-10 East corridor within the study limits. Corridor needs are defined through a review of the difference in baseline corridor performance (Task 2) and the performance objectives (Task 3) for each of the five performance areas used to characterize the health of the I-10 East corridor: pavement, bridge, mobility, safety, and freight. The product of Working Paper 4 is actionable performance needs that can be addressed through strategic investments in corridor preservation, modernization, and expansion.

1.4 Corridor Overview

The I-10 East corridor is a major east-to-west all-weather transcontinental interstate highway that connects California (Santa Monica) with Florida (Jacksonville). I-10 is a major transportation artery route for freight as well as passenger vehicular traffic, connecting major metropolitan cities throughout the southern part of the United States. I-10 plays a key role in the transportation infrastructure of southern Arizona, contributing to its economic success.

I-10 provides the most direct link between the greater Phoenix and Tucson, Arizona areas and Los Angeles, California to the west, and major Texas and Florida cities to the east. I-10 provides a principal road link for freight traffic from the ports of California. This study builds on earlier planning efforts in developing and applying a performance-based process for prioritizing improvements to meet present and future needs in the corridor.

1.5 Study Location and Corridor Segments

The I-10 corridor is being studied in two separate corridor profile studies. One study extends from California State line to SR 85, and this study extends from SR 202L to New Mexico State line. For the purposes of this Corridor Profile Study, the portion from SR 202L to New Mexico State line is referred to as I-10 East.

The I-10 East corridor is 232 miles long, from SR 202L (milepost [MP] 160) to the Arizona-New Mexico state line (MP 392). The I-10 East corridor is located in three ADOT Districts (Central, Southcentral and Southeast); four planning areas (Maricopa Association of Governments (MAG), Sun Corridor Metropolitan Planning Organization (SCMPO), Pima Association of Governments (PAG), and South Eastern Arizona Governments Organization (SEAGO); and four counties (Maricopa, Pinal, Pima, and Cochise).

The I-10 East study corridor has been divided into 16 segments to allow for an appropriate level of detailed needs analysis, performance evaluation, and comparison between different segments of the corridor. These corridor segments are described in **Table 1** and shown in **Figure 2**.

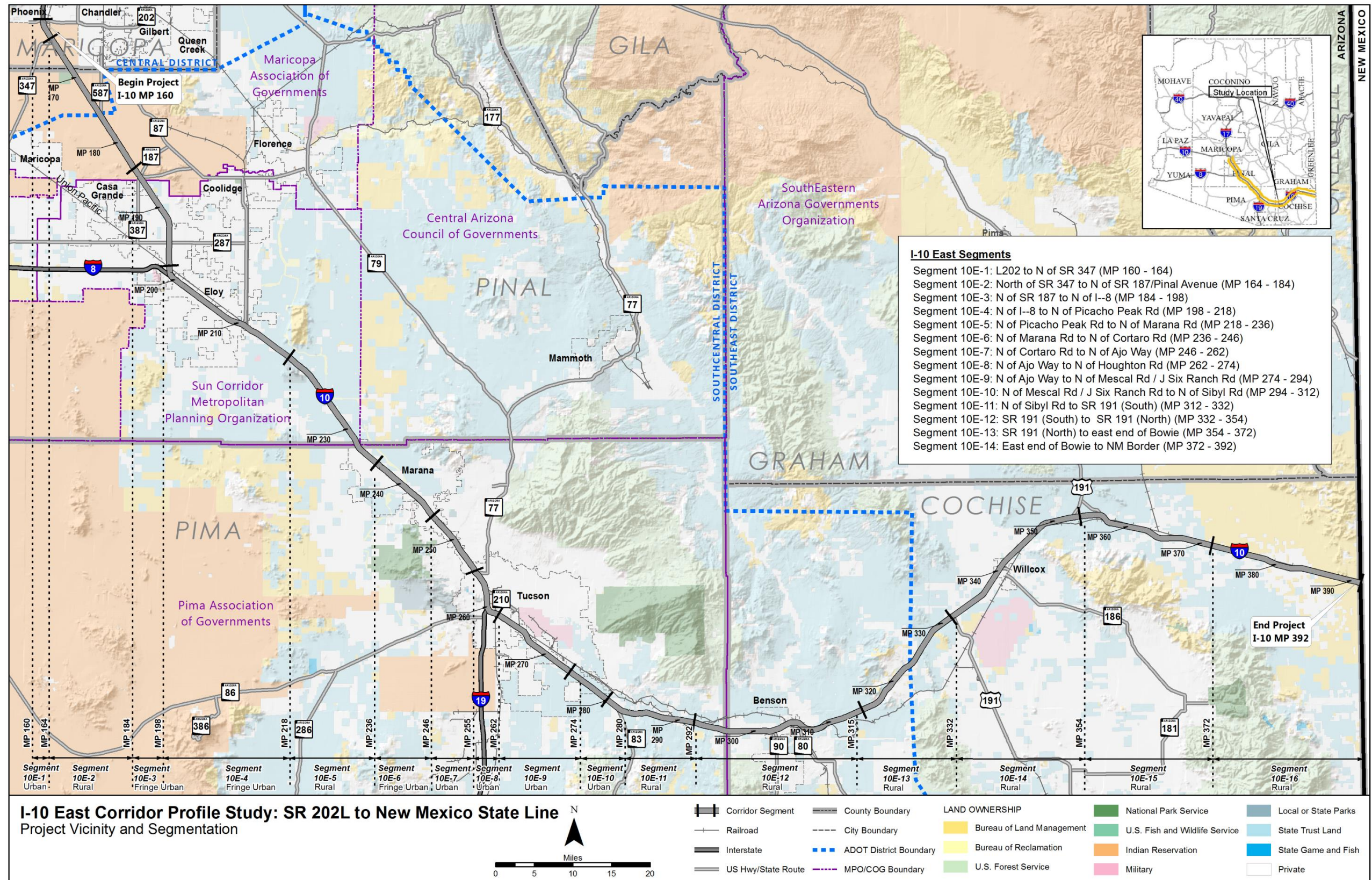
Table 1: I-10 East Corridor Segmentation

Segment	Begin	End	Approximate Begin Milepost	Approximate End Milepost	Approximate Length (miles)	Through Lanes (EB, WB)	2014 Average Annual Daily Traffic Volume (vpd)	Character Description
10E-1	Loop 202	North of SR 347	160	164	4	4-6	95,000	Begins at SR 202L (Santan Freeway) system traffic interchange, posted speed is 65 miles per hour (mph), characterized as “Urban Freeway.” A lane drop occurs at about MP 162.5. South of PeCOS Rd, this segment leaves the Phoenix metropolitan area and traverses the Gila River Indian Community.
10E-2	North of SR 347	North of SR 187/Pinal Ave	164	184	20	4	51,800	Most of this segment is characterized as “Rural 4-Lane Freeway;” posted speed is 75 mph. Rest areas are at MP 182 (EB) and MP 183 (WB). This segment is entirely within the Gila River Indian Community. Rising grade east of Gila River bridge crossing (MP 173) to end of segment.
10E-3	North of SR 187/Pinal Ave	North of I-8	184	198	14	4-6	40,300	Most of this segment is characterized as “Urban or Rural 6-Lane Freeway;” widens to three lanes in each direction at MP 187; drops to two lanes at MP 197. Adjacent to urbanizing area of Casa Grande.
10E-4	North of I-8	North of Picacho Rd	198	218	20	4-6	38,800	This segment encompasses several different operation environments (“Rural 4-Lane,” “Urban 4-Lane,” and “Urban or Rural 6-Lane Freeway”). The I-8 system interchange is at MP 199. Portions of the segment are two lanes in each direction (west of MP 200 and between MPs 210 and 212.5). Adjacent to Eloy.
10E-5	North of Picacho Rd	North of Marana	218	236	18	6	41,900	Characterized as “Urban or Rural 6-Lane Freeway;” three lanes in each direction; posted speed of 75 mph. Area is largely rural, undeveloped desert; Union Pacific Railroad runs parallel on northern side of this segment, continuing to Tucson.
10E-6	North of Marana	North of Cortaro Rd	236	246	10	6	61,200	Characterized at “Urban or Rural 6-Lane Freeway;” three lanes in each direction; posted speed of 75 mph. Traverses Marana as freeway enters the Tucson urbanized area.
10E-7	North of Cortaro Rd	SR 77	246	255	9	6	108,500	Characterized at “Urban or Rural 6-Lane Freeway;” three lanes in each direction; posted speed decreases at MP 246 to 65 mph through Tucson.
10E-8	SR 77	North of Ajo Way	255	262	7	6-8	117,600	Most of this segment is characterized as “Urban > 6-Lane Freeway;” widens to four lanes in each direction at MP 255, before dropping a lane at MP 259 (I-19). This segment includes the system traffic interchange with I-19 and serves the urbanized Tucson area.
10E-9	North of Ajo Way	Houghton Rd	262	274	12	4-6	59,500	Characterized as “Urban 4-Lane Freeway;” drops to two lanes in each direction at MP 263; posted speed limit increases to 75 mph at MP 271. The segment ends at Houghton Rd, which is considered the eastern extent of the Tucson urbanized area; generally rural to the east.
10E-10	Houghton Rd	SR 83	274	280	6	4	34,200	Characterized as “Urban 4-Lane Freeway.” The area is largely rural, with the exception of Vail (unincorporated place) at the SR 83 junction.
10E-11	SR 83	Empirita Rd	280	292	12	4	26,700	Characterized as “Rural 4-Lane Freeway > 25K;” posted speed reduced to 65 mph at MP 288 for approximately 1 mile. Exit 292 (Empirita Rd) has an unconventional “folded diamond” interchange type.
10E-12	Empirita Rd	ZR Ranch Rd	292	315	23	4	21,100	Characterized as “Rural 4-Lane Freeway < 25K.” This segment traverses Benson.

Table 1: I-10 East Corridor Segmentation

Segment	Begin	End	Approximate Begin Milepost	Approximate End Milepost	Approximate Length (miles)	Through Lanes (EB, WB)	2014 Average Annual Daily Traffic Volume (vpd)	Character Description
10E-13	ZR Ranch Rd	SR 191 (South)	315	332	17	4	16,700	Characterized as “Rural 4-Lane Freeway < 25K.” This segment has steep grades eastbound (as high as 6 percent) and westbound (as high as 4 percent), causing considerable truck slowing; highest point on I-10 is at MP 321 (4,937 feet).
10E-14	SR 191 (South)	SR 191 (North)	332	354	22	4	15,400	Characterized as a “Rural 4-Lane Freeway < 25K;” traverses Willcox. US 191 is coincident with this segment.
10E-15	SR 191 (North)	Eastern End of Bowie	354	372	18	4	14,100	Characterized as “Rural 4-Lane Freeway < 25K.” At MP 362, the freeway makes a wide sweeping curve around Bowie, and unincorporated census-designated place.
10E-16	Eastern End of Bowie	New Mexico State Line	372	392	20	4	12,200	Characterized as a “Rural 4-Lane Freeway < 25K.” At MP 378, the freeway makes a wide sweeping curve around San Simon, at unincorporated census-designated place. The San Simon commercial vehicle port of entry (POE) is at MP 383, and a rest area is at MP 388.

Figure 2: Segmentation Map



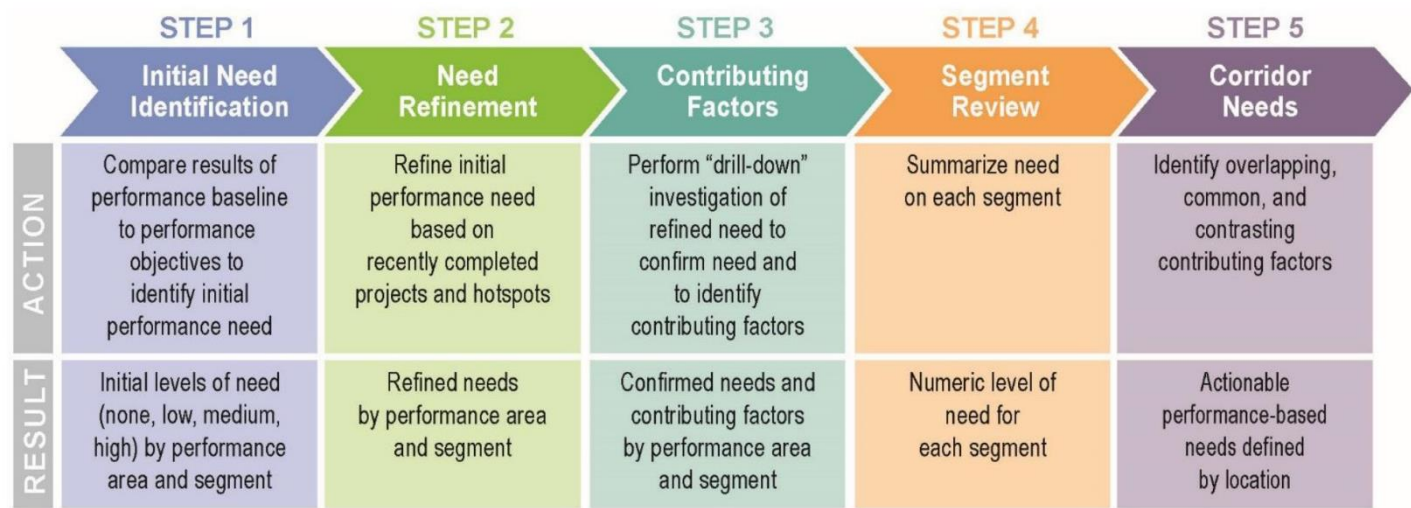
2.0 NEEDS ASSESSMENT PROCESS

A collaborative process involving ADOT Multimodal Planning Department (MPD) staff and the corridor profile study teams was used to develop a framework for the performance-based needs assessment process. The following guiding principles were developed as an initial step in process development:

- Corridor needs are defined as the difference between corridor performance and the performance objectives.
- The needs assessment process should be systematic, progressive, and repeatable, but also include engineering judgment.
- The process should consider all primary and secondary performance measures developed for the study.
- The process should develop multiple need levels including programmatic needs for the entire length of the corridor, performance area-specific needs, segment-specific needs, and location-specific needs (defined by milepost limits).
- The process should produce actionable needs that can be addressed through strategic investments in corridor preservation, modernization, and expansion.

The performance-based needs assessment process is illustrated in **Figure 3** and described in the following sections of the working paper.

Figure 3: Needs Assessment Process



2.1 Step 1: Initial Need Identification

The first step in the needs assessment process links baseline (existing) corridor performance documented in Working Paper 2 with performance objectives documented in Working Paper 3. In this step, the baseline corridor performance is compared to the performance objectives to provide a starting point for the identification of initial performance needs. This mathematical comparison results in an initial need rating of "None", "Low", "Medium", or "High" for each primary and

secondary performance measure. An illustrative example of this process for the pavement performance measure is shown in **Figure 4**.

Figure 4: Initial Need Ratings in Relation to Baseline Performance (Bridge Example)

Performance Thresholds	Performance Level	Initial Level of Need	Description
6.5	Good	None	All levels of Good and top 1/3 of Fair (>6.0)
	Good		
	Good		
5.0	Fair	Low	Middle 1/3 of Fair (5.5-6.0)
	Fair		
	Fair	Medium	Lower 1/3 of Fair and top 1/3 of Poor (4.5-5.5)
	Poor		
	Poor		
	Poor	High	Lower 2/3 of Poor (<4.5)

Initial levels of needs for each performance measure are combined to produce a weighted initial need rating for each segment. Values of 0, 1, 2, and 3 are assigned to the initial need levels of "None", "Low", "Medium", and "High", respectively. A weight of 1.0 is applied to the Performance Index need and equal weights of 0.20 are applied to each need for each secondary performance measure. For directional secondary performance measures, each direction of travel receives a weight of 0.10. The secondary performance measure needs are added to the need from the Primary Index to create a cumulative measure of need. The resulting weighted initial level of need is assigned a level of "None", "Low", "Medium", or "High". With this approach, the resulting segment level of need is always equal to or higher than the Primary Index need.

2.2 Step 2: Need Refinement

In Step 2, the initial level of need for each segment is refined using the following information and engineering judgment.

- If an initial need is not identified, the existence of hot spots in the segment is justification for increasing the level of need from "None" to "Low"
- Recently completed projects or projects under construction may be justification for lowering or eliminating a need
- Programmed projects should not be used to lower the initial need because the project may not be implemented as planned. In addition, further investigations may suggest that changes in the scope of a programmed project may be warranted

The resulting final need (potential increase, decrease, or no change from initial need) is carried forward for further evaluation in Step 3.

2.3 Step 3: Contributing Factors

In Step 3, a more detailed review of the condition and performance data available from ADOT is conducted to identify contributing factors to the need. Typically, the same databases that are

used to develop the baseline performance serve as the principal sources for the more detailed analysis. The databases used for diagnostic analysis are listed below.

Pavement Performance Area

- Pavement Rating Database

Bridge Performance Area

- Bridge Information and Storage System

Mobility Performance Area

- Highway Performance Monitoring System (HPMS) Database
- Arizona Travel Demand Model (AZTDM)
- HERE Travel Time Database
- Highway Condition Reporting System (HCRS) Closure Database

Safety Performance Area

- Crash Database

Freight Performance Area

- HERE Database
- HCRS Database

In addition, other sources are considered to help identify the contributing factors, such as:

- Maintenance history (from ADOT PeCOS for pavement), the level of past investments, or trends in historical data are used to help provide context for pavement and bridge history.
- Field observations from ADOT district personnel could be used to provide additional information regarding a need that has been identified
- Previous studies could be used to provide additional information regarding contributing factors to a need that has been identified

Step 3 results in the identification of contributing factors to needs by segment (and milepost locations, if appropriate) that can be addressed through investments in preservation, modernization, and expansion projects to improve corridor performance.

2.4 Step 4: Segment Review

In this step, the needs from Step 2 are quantified for each segment to numerically estimate the level of need for each segment. Values of 0, 1, 2, and 3 are assigned to the final need levels (from Step 2) of “None”, “Low”, “Medium”, and “High”, respectively. A weight factor of 1.5 is applied to the performance areas that are identified as Emphasis Areas in Working Paper 3 and a weighted

average need is calculated for each segment. The resulting average need value can be used to compare needs across corridors and to determine the location of the highest needs.

2.5 Step 5: Corridor Needs

In this step, the needs and contributing factors for each performance area are reviewed on a segment-by-segment basis to identify actionable needs and to facilitate the formation of solutions that address multiple performance areas and contributing factors. The intent of this process is to identify overlapping, common, and contrasting needs to help develop strategic solutions. This step results in the identification of corridor needs by specific location.

3.0 PAVEMENT PERFORMANCE AREA NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the I-10 East corridor for the Pavement Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

3.1 Step 1: Initial Pavement Needs

The baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the I-10 East corridor were used to determine the initial pavement needs, as described in Section 2.1. The pavement condition data used to calculate baseline performance was provided by ADOT for the timeframe from 2014 through 2015.

Step 1 uses the scores for the Pavement Index primary performance measure and two secondary performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The two secondary performance measures are Directional Pavement Serviceability Rating (PSR) and Percent Pavement Failure.

The performance scores, performance objectives, and initial levels of need for each pavement performance measure and for all pavement performance measures combined are shown in **Table 2**.

For the Pavement Index and Directional PSR, zero segments report a “Medium” or “High” level of need. For Percent Pavement Failure, zero segments report a “High” level of need and two segments report a “Medium” level of need. For all pavement performance measures combined, zero segments report a “High” or “Medium” level of initial need.

3.2 Step 2: Final Pavement Needs

Once the initial pavement needs by segment for the I-10 East corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of pavement hot spots as well as relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 3**.

Pavement Hot Spots

There are six segments containing one or more pavement failure hot spots. The locations of pavement hot spots are listed in **Table 3**. The seven hot spots are within segments that did not have an identified initial need, so adjustments were made to the level of need to “Low” for the four segments containing hot spots where the level before adjustment was “None”.

Recently Completed and Under-Construction Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any

projects completed or under construction after 2015 that have the potential to mitigate a pavement need on a corridor segment.

There are three segments containing recently completed or under-construction projects as shown in **Table 3**. Segment 12 had few hot spots where a recent repaving project was conducted eliminating any future need to this particular segment.

Planned or Programmed Projects

Information was noted in **Table 3** on pavement-related planned and programmed projects and other issues identified in previous reports summarized in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

3.3 Step 3: Pavement Contributing Factors

The final needs for the I-10 East corridor were further investigated as described in Section 2.3. ADOT provided pavement rehabilitation project data for the last 20 years that was used to estimate the level of historical investment in each segment and is summarized in **Figure 5**.

In addition, PeCOS data was collected for each segment to estimate the level of pavement maintenance activity. If the PeCOS data showed a “High” level of maintenance investment, the overall historical investment was elevated by one need level (from “Medium” to “High”, for example). There are two segments (7 and 12) with a “High” level of overall historical investment. Additional information regarding the determination of the level of historical investment is contained in **Appendix A**.

For the Pavement Performance Area, no additional data is readily available so the contributing factors simply identify the specific locations of needs, the level of historical investment, and any additional supporting information available from the ADOT Districts. Adjustments to historical investment levels were made based on any recent roadway improvement projects such as roadway widening which may influence the investment cost. A summary of this process is shown in **Table 4**.

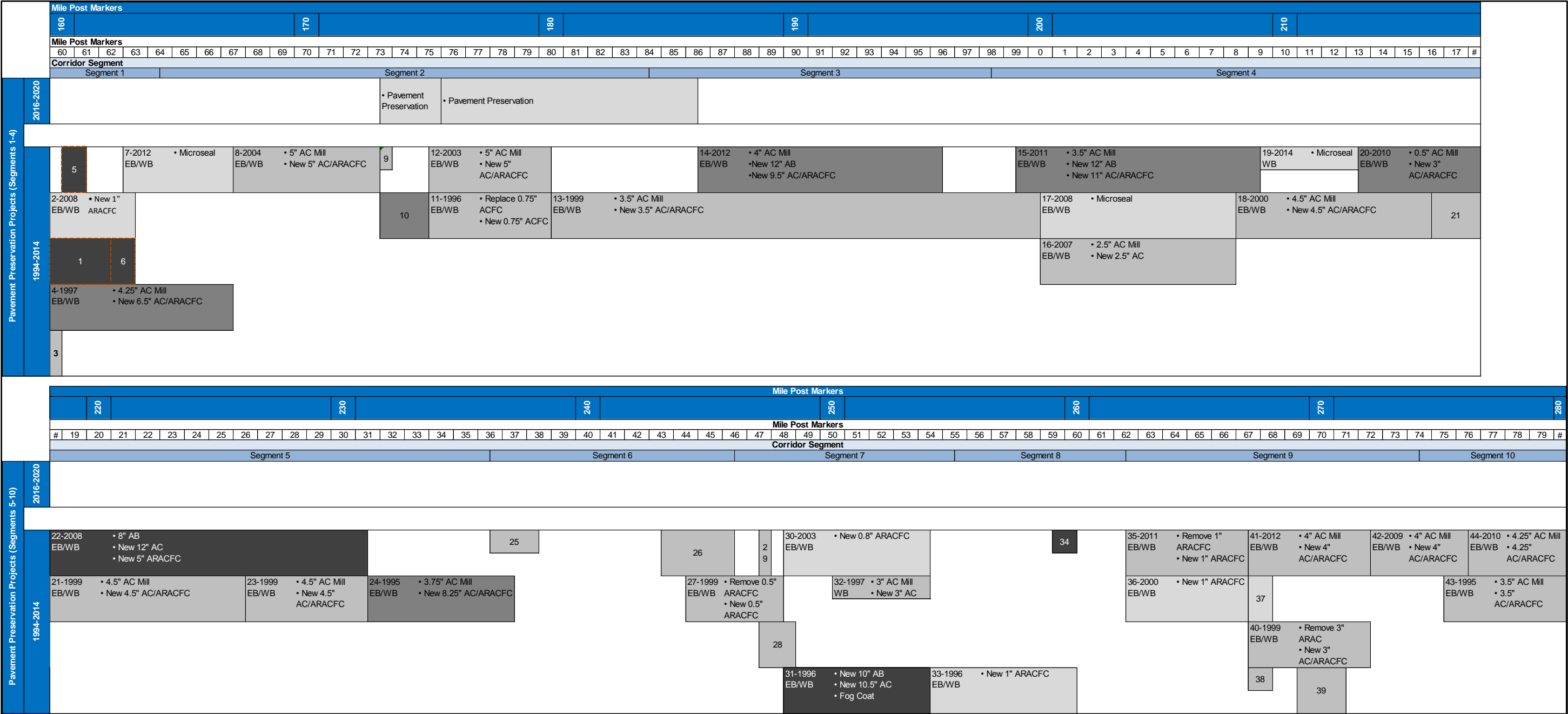
Table 2: Initial Pavement Needs (Step 1)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Facility Type	Pavement Index			Directional PSR					% Pavement Failure			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
							EB	WB		EB	WB				
10E-1	4	160-164	Interstate	3.87	Fair or Better	None	3.90	3.85	Fair or Better	None	None	0.00%	Fair or Better	None	None
10E-2	20	164-184	Interstate	3.69	Fair or Better	None	3.79	3.53	Fair or Better	None	Low	17.50%	Fair or Better	Medium	Low
10E-3	14	184-198	Interstate	4.34	Fair or Better	None	4.18	4.20	Fair or Better	None	None	8.11%	Fair or Better	None	None
10E-4	20	198-218	Interstate	4.30	Fair or Better	None	4.09	4.16	Fair or Better	None	None	3.64%	Fair or Better	None	None
10E-5	18	218-236	Interstate	4.33	Fair or Better	None	4.37	4.24	Fair or Better	None	None	0.00%	Fair or Better	None	None
10E-6	10	236-246	Interstate	4.24	Fair or Better	None	4.29	4.22	Fair or Better	None	None	0.00%	Fair or Better	None	None
10E-7	9	246-255	Interstate	4.01	Fair or Better	None	4.03	3.91	Fair or Better	None	None	0.00%	Fair or Better	None	None
10E-8	7	255-262	Interstate	3.90	Fair or Better	None	3.92	3.89	Fair or Better	None	None	24.00%	Fair or Better	Medium	Low
10E-9	12	262-274	Interstate	4.26	Fair or Better	None	4.04	4.07	Fair or Better	None	None	0.00%	Fair or Better	None	None
10E-10	6	274-280	Interstate	4.46	Fair or Better	None	4.28	4.23	Fair or Better	None	None	0.00%	Fair or Better	None	None
10E-11	12	280-292	Interstate	4.16	Fair or Better	None	3.99	4.19	Fair or Better	None	None	0.00%	Fair or Better	None	None
10E-12	23	292-315	Interstate	4.06	Fair or Better	None	3.94	3.99	Fair or Better	None	None	8.70%	Fair or Better	None	None
10E-13	17	315-332	Interstate	4.51	Fair or Better	None	4.25	4.45	Fair or Better	None	None	0.00%	Fair or Better	None	None
10E-14	22	332-354	Interstate	4.11	Fair or Better	None	3.94	4.04	Fair or Better	None	None	0.00%	Fair or Better	None	None
10E-15	18	354-372	Interstate	4.30	Fair or Better	None	4.09	4.18	Fair or Better	None	None	2.78%	Fair or Better	None	None
10E-16	20	372-392	Interstate	4.52	Fair or Better	None	4.32	4.30	Fair or Better	None	None	0.00%	Fair or Better	None	None
Pavement Emphasis Area?	No	Corridor Weighted Average		4.21	Fair or Better	None									

Table 3: Final Pavement Needs (Step 2)

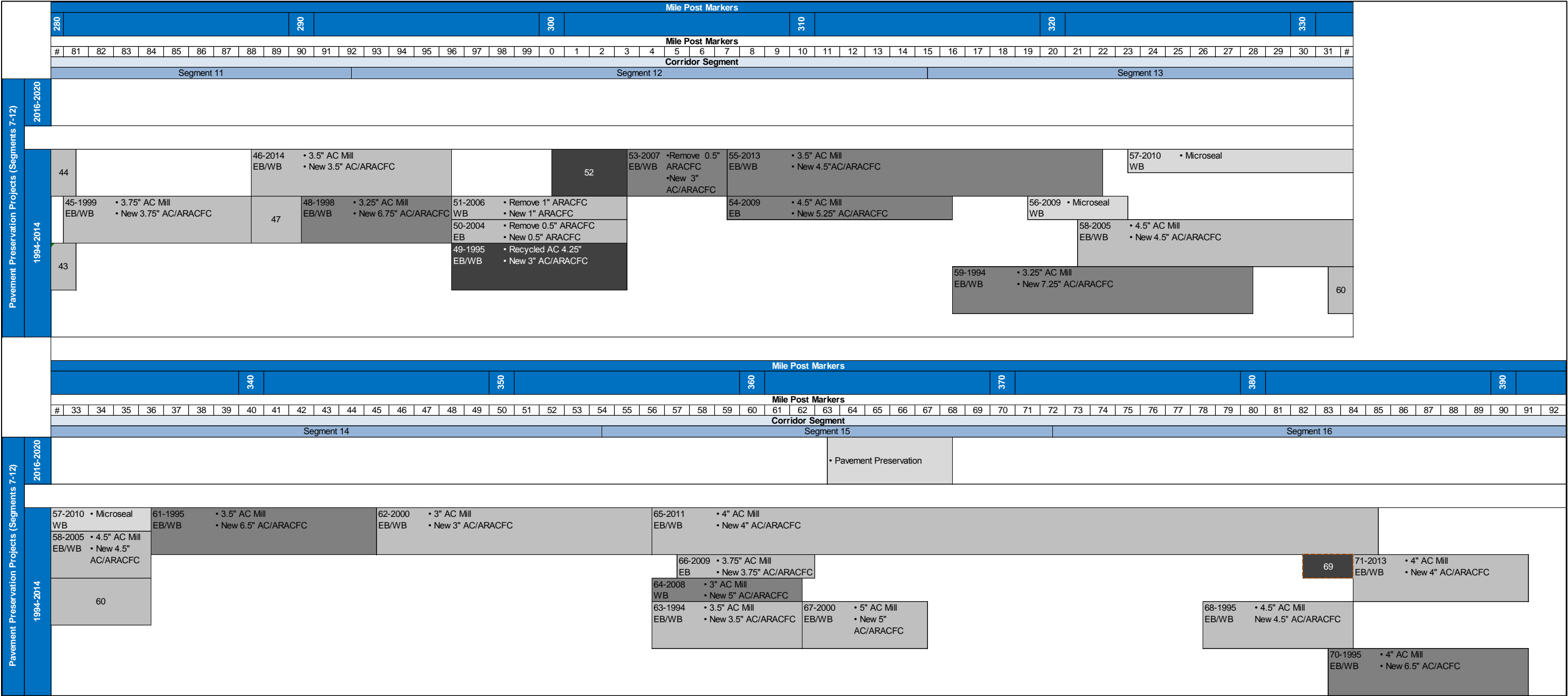
Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Need Adjustments		Final Need	Comments (may include programmed projects or issues from previous reports)
				Hot Spots	Previous Projects (which supersede condition data)		
10E-1	4	160-164	None			None	Results are based on 2014 IRI values, aerial lookup and site visit
10E-2	20	164-184	Low	MP 164-166, 175-178, and 182-183	Pavement preservation project at MP 164 – 168 (2015)	Low	Maintain “Low” but had one recent project at one of the three hot spot locations. Project programmed for 2018 at MP 173 – 175 and a project tentatively programmed for 2020 at MP 175 – 187.
10E-3	14	184-198	None	MP 184-186 and 197-198		Low	Presence of Hot Spot elevated need from “None” to “Low”.
10E-4	20	198-218	None	MP 210-211		Low	Presence of Hot Spot elevated need from “None” to “Low”.
10E-5	18	218-236	None			None	
10E-6	10	236-246	None			None	
10E-7	9	246-255	None			None	
10E-8	7	255-262	Low	MP 260-262		Low	Presence of Hot Spot did not change the need as the initial need is “Low”
10E-9	12	262-274	None			None	
10E-10	6	274-280	None			None	
10E-11	12	280-292	None		Repaving project at MP 181 – 184 (2015)	None	
10E-12	23	292-315	None	MP 292-294, 296-297, and 298-299	Repaving project at MP 290 – 301 (2015)	None	Due to recent project at all three hot spot locations need was eliminated.
10E-13	17	315-332	None			None	
10E-14	22	332-354	None			None	
10E-15	18	354-372	None	MP 366-367		Low	Presence of Hot Spot elevated need from “None” to “Low”; project tentatively programmed for 2017 at MP 363 - 368.
10E-16	20	372-392	None		Passing Lane at MP 190 - 195 (NB)	None	

Figure 5: Pavement History



* Reference number represents Pavement Treatment type noted in Legend

Figure 5: Pavement History (continued)



* Reference number represents Pavement Treatment type noted in Legend

Figure 5: Pavement History (continued)

Pavement Treatment Reference Numbers		Legend	
1. 2003 (EB/WB): New 4" AB, New 13" PCCP	37. 2005 (EB/WB): New 3" CR, New 0.5" ACFC	<div></div> New Paving or Reconstruction	<div></div> PCCP Pavement Border
2. 2008 (EB/WB): New 1" ARACFC	38. 1996 (EB/WB): 2" AC Mill, New 2" AC	<div></div> Mill and Overlay (Adding Structural Thickness)	<div></div> AC Pavement Border
3. 1997 (EB/WB): 3" AC Mill, New 3" AC/ARACFC	39. 1996 (EB/WB): 2" AC Mill, New 2" AC/ARACFC	<div></div> Mill and Replace (No Change Structural Thickness)	
4. 1997 (EB/WB): 4.25" AC Mill, New 6.5" AC/ARACFC	40. 1999 (EB/WB): Remove 3" ARAC, New 3" AC/ARACFC	<div></div> Fog Coat or Thin Overlay Treatments	
5. 2011 (EB/WB): New 5" AC/ARACFC, New 4" PCC	41. 2012 (EB/WB): 4" AC Mill, New 4" AC/ARACFC		
6. 2004 (EB/WB): New 4" AB, New 14" PCC	42. 2009 (EB/WB): 4"AC Mill, New 4" AC/ARACFC		
7. 2012 (EB/WB): Microseal	43. 1995 (EB/WB): 3.5" AC Mill, 3.5" AC/ARACFC		
8. 2004 (EB/WB): 5" AC Mill, New 5" AC/ARACFC	44. 2010 (EB/WB): 4.25" AC Mill, New 4.25" AC/ARACFC		
9. 1998 (WB): 2.5" AC Mill, New 5" AC/ARACFC	45. 1999 (EB/WB): 3.75" AC Mill, New 3.75" AC/ARACFC		
10. 1995 (EB/WB): 7" AC Mill, New 8.5" AC/ARACFC	46. 2014 (EB/WB): 3.5" AC Mill, New 3.5" AC/ARACFC		
11. 1996 (EB/WB): Replace 0.75" ACFC, New 0.75" ACFC	47. 2005 (EB/WB): 2" AC Mill, New 2" AC		
12. 2003 (EB/WB): 5" AC Mill, New 5" AC/ARACFC	48. 1998 (EB/WB): 3.25" AC Mill, New 6.75" AC/ARACFC		
13. 1999 (EB/WB): 3.5" AC Mill, New 3.5" AC/ARACFC	49. 1995 (EB/WB): Recycled AC 4.25", 3" AC/ARACFC		
14. 2012 (EB/WB): 4" AC Mill, New 12" AB, New 9.5" AC/ARACFC	50. 2004 (EB): Remove 0.5" ARACFC, New 0.5" ARACFC		
15. 2011 (EB/WB): 3.5" AC Mill, New 12" AB, New 11" AC/ARACFC	51. 2006 (WB): Remove 1" ARACFC, New 1" ARACFC		
16. 2007 (EB/WB): 2.5" AC Mill, New 2.5" AC	52. 2012 (EB/WB): New 10" AB, New 10" PCC, New 0.5" ARACFC		
17. 2008 (EB/WB): Microseal	53. 2007 (EB/WB): Remove 0.5" ARACFC, New 3" ARACFC		
18. 2000 (EB/WB): 4.5" AC Mill, New 4.5" AC/ARACFC	54. 2009 (EB): 4.5" AC Mill, New 5.25" AC/ARACFC		
19. 2014 (WB): Microseal	55. 2013 (EB/WB): 3.5" AC Mill, New 4.5" AC/ARACFC		
20. 2010 (EB/WB): 0.5" AC Mill, New 3" AC/ARACFC	56. 2009 (WB): Microseal		
21. 1999 (EB/WB): 4.5" AC Mill, New 4.5" AC/ARACFC	57. 2010 (WB): Microseal		
22. 2008 (EB/WB): 8" AB, New 12" AC, New 5" ARACFC	58. 2005 (EB/WB): 4.5" AC Mill, New 4.5" AC/ARACFC		
23. 1999 (EB/WB): 4.5" AC Mill, New 4.5" AC/ARACFC	59. 1994 (EB/WB): 3.25" AC Mill, New 7.25" AC/ARACFC		
24. 1995 (EB/WB): 3.75"AC Mill, New 8.25" AC/ARACFC	60. 1998 (EB/WB): Remove 2.5" ARAC, New 2.5" ARAC/ARACFC		
25. 2004 (EB/WB): Remove 0.5" ACFC, New 0.5" ARFC	61. 1995 (EB/WB): 3.5" AC Mill, New 6.5" AC/ARACFC		
26. 2011 (EB/WB): Remove 0.5" ACFC, New 0.5" ARFC	62. 2000 (EB/WB): 3" AC Mill, New 3" AC?ARACFC		
27. 1999 (EB/WB): Remove 0.5" ARACFC, New 0.5" ARACFC	63. 1994 (EB/WB): 3.5" AC Mill, New 3.5" AC./RACFC		
28. 2004 (EB/WB): 3.5" AC Mill, New 3.5" AC/ARACFC	64. 2008 (WB): 3" AC Mill, New 5" AC/ARACFC		
29. 2006 (EB/WB): 3" AC Mill, New 3" AC/ARACFC	65. 2011 (EB/WB): 4" AC Mill, New 4" AC/ARACFC		
30. 2003 (EB/WB): New 0.8" ARACFC	66. 2009 (EB): 3.75" AC Mill, New 3.75" AC/ARACFC		
31. 1996 (EB/WB): New 10" AB, New 10.5" AC Fog Coat	67. 2000 (EB/WB): 5" AC Mill, New 5" AC/ARACFC		
32. 1997 (WB): 3" AC Mill, New 3" AC	68. 1995 (EB/WB): 4.5" AC Mill, New 4.5" AC/ARACFC		
33. 1996 (EB/WB): New 1" ARACFC	69. 1996 (EB/WB): New 4" AC, New 11.5" PCC		
34. 2005 (EB/WB): New 14" AB, New 6" AC	70. 1995 (EB/WB): 4" AC Mill, New 6.5" AC/ACFC		
35. 2011 (EB/WB): Remove 1" ARACFC, New 1" ARACFC	71. 2013 (EB/WB): 4" AC Mill, New 4" AC/ARACFC		
36. 2000 (EB/WB): New 1" ARACFC			

Table 4: Pavement Needs Contributing Factors (Step 3)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Final Need	Bid History Investment	PeCOS History Investment	Resulting Historical Investment	Contributing Factors and Comments
10E-1	4	160-164	None	Medium	Low	Medium	No contributing factors identified
10E-2	20	164-184	Low	Low	Low	Low	Hot spots MP 175-178 and 182-183 and programmed projects will address both hot spots
10E-3	14	184-198	Low	Medium	Low	Medium	Hot spots MP 184-186 and 197-198. No contributing factors identified
10E-4	20	198-218	Low	Low	Low	Low	No contributing factors identified
10E-5	18	218-236	None	Low	Low	Low	No contributing factors identified
10E-6	10	236-246	None	Low	High	Medium	No contributing factors identified
10E-7	9	246-255	None	High	High	High	No contributing factors identified
10E-8	7	255-262	Low	Low	High	Medium	Hot spot MP 260-262. No contributing factors identified
10E-9	12	262-274	None	Medium	Low	Medium	No contributing factors identified
10E-10	6	274-280	None	Medium	Low	Medium	No contributing factors identified
10E-11	12	280-292	None	Low	Medium	Low	No contributing factors identified
10E-12	23	292-315	None	High	Medium	High	Recent pavement projects eliminated any need and contributed to “High” historical investment.
10E-13	17	315-332	None	Medium	Low	Medium	No contributing factors identified
10E-14	22	332-354	None	Medium	Low	Medium	No contributing factors identified
10E-15	18	354-372	Low	Medium	Medium	Medium	Hot spot MP 366-367. No contributing factors identified
10E-16	20	372-392	None	Medium	Medium	Medium	No contributing factors identified

4.0 BRIDGE PERFORMANCE AREA NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the I-10 East corridor for the Bridge Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

4.1 Step 1: Initial Bridge Needs

The baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the I-10 East corridor were used to determine the initial bridge needs, as described in Section 2.1. The bridge condition data used to calculate baseline performance was provided by ADOT for 2012 to 2015.

Step 1 uses the scores for the Bridge Index primary performance measure and three secondary performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The three secondary performance measures are Bridge Rating, Bridge Sufficiency, and Percent Functionally Obsolete Bridges).

The performance scores, performance objectives, and initial levels of need for each bridge performance measure and for all bridge performance measures combined are shown in **Table 5**.

For the Bridge Index, zero segments report a “High” level of need and three segments report a “Medium” level of need. For the Bridge Rating, zero segments report a “High” level of need and four segments report a “Medium” level of need. For Bridge Sufficiency, zero segments report a “High” or “Medium” level of need. For Percent Functionally Obsolete Bridges, two segments report a “High” level of need and five segments report a “Medium” level of need. For all bridge performance measures combined, one segment reports a “High” level of initial need and four segments report a “Medium” level of initial need.

4.2 Step 2: Final Bridge Needs

Once the initial bridge needs by segment for the I-10 East corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of bridge hot spots as well as relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 6**.

Bridge Hot Spots

There are nine segments containing one or more bridge hot spots, which are bridges with a single rating of 4 or less, or multiple ratings of 5 between the deck, superstructure, and substructure. The locations of bridge hot spots are listed in **Table 6**. All hot spots are within segments that already have an identified initial need, so no adjustments were made to the need level of any segments to account for hot spots.

Recently Completed and Under-Construction Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2015 that have the potential to mitigate a bridge need on a corridor segment.

There are two segments containing recently completed or under-construction projects that would supersede the bridge condition data, as shown in **Table 3**. However, the projects did not address all the hot spots, therefore, no adjustments were made to the need level of any segments to account for recently completed or under-construction projects.

Planned or Programmed Projects

Information was noted in **Table 6** on bridge-related planned and programmed projects and other issues identified in previous reports in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

4.3 Step 3: Bridge Contributing Factors

The final needs for the I-10 East corridor were further investigated as described in Section 2.3. ADOT provided historical bridge rating data for the last 17 years that was used to investigate historical trends for each bridge and is summarized in **Figure 6**.

There are 13 segments containing bridges identified as having possible historical concerns. The locations of bridges with possible historical concerns are listed in **Table 6**. There are 13 segments containing bridges identified as being functionally obsolete. The number of functionally obsolete bridges is also shown in **Table 6**. While historical concerns and functional obsolescence were not used to adjust the level of need, they were listed in **Table 6** as input to the identification of contributing factors.

The current bridge ratings were reviewed to determine which rating (or ratings) were less than 6 (deck, superstructure, substructure, or structural evaluation rating). **Table 7** provides a summary of this information, identifies the bridges with potential historical concerns, and provides any additional information related to the contributing factors.

Table 5: Initial Bridge Needs (Step 1)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Bridge Index			Bridge Rating			Bridge Sufficiency			% Functionally Obsolete Bridges			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
10E-1	4	160-164	4	7.00	Fair or Better	None	7	Fair or Better	None	92.3	Fair or Better	None	32.1%	Fair or Better	Medium	Low
10E-2	20	164-184	10	5.63	Fair or Better	Low	5	Fair or Better	Low	82.5	Fair or Better	None	34.0%	Fair or Better	Medium	Low
10E-3	14	184-198	7	6.00	Fair or Better	None	6	Fair or Better	None	90.4	Fair or Better	None	0.0%	Fair or Better	None	None
10E-4	20	198-218	19	5.60	Fair or Better	Low	5	Fair or Better	Low	86.9	Fair or Better	None	48.2%	Fair or Better	Medium	Low
10E-5	18	218-236	4	5.43	Fair or Better	Medium	4	Fair or Better	Medium	88.9	Fair or Better	None	0.0%	Fair or Better	None	Medium
10E-6	10	236-246	11	6.81	Fair or Better	None	5	Fair or Better	Low	94.6	Fair or Better	None	13.0%	Fair or Better	None	Low
10E-7	9	246-255	15	5.61	Fair or Better	Low	4	Fair or Better	Medium	86.2	Fair or Better	None	21.8%	Fair or Better	Low	Medium
10E-8	7	255-262	15	6.13	Fair or Better	None	5	Fair or Better	Low	91.0	Fair or Better	None	0.0%	Fair or Better	None	Low
10E-9	12	262-274	26	4.99	Fair or Better	Medium	4	Fair or Better	Medium	81.9	Fair or Better	None	13.9%	Fair or Better	None	Medium
10E-10	6	274-280	5	5.65	Fair or Better	Low	5	Fair or Better	Low	85.0	Fair or Better	None	71.1%	Fair or Better	High	Medium
10E-11	12	280-292	6	6.56	Fair or Better	None	5	Fair or Better	Low	91.6	Fair or Better	None	11.7%	Fair or Better	None	Low
10E-12	23	292-315	22	5.63	Fair or Better	Low	4	Fair or Better	Medium	94.5	Fair or Better	None	8.2%	Fair or Better	None	Low
10E-13	17	315-332	4	5.35	Fair or Better	Medium	5	Fair or Better	Low	80.9	Fair or Better	None	72.2%	Fair or Better	High	High
10E-14	22	332-354	6	5.85	Fair or Better	Low	5	Fair or Better	Low	89.8	Fair or Better	None	43.5%	Fair or Better	Medium	Low
10E-15	18	354-372	15	5.71	Fair or Better	Low	5	Fair or Better	Low	91.2	Fair or Better	None	20.5%	Fair or Better	None	Low
10E-16	20	372-392	12	5.86	Fair or Better	Low	5	Fair or Better	Low	90.5	Fair or Better	None	35.6%	Fair or Better	Medium	Low
Bridge Emphasis Area?	No	Corridor Weighted Average		5.77	Fair or Better	Low										

Table 6: Final Bridge Needs (Step 2)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Initial Need	Need Adjustments		Final Need	Historical Review	# Functionally Obsolete Bridges	Comments
					Hot Spots (Rating of 4 or multiple 5's)	Previous Projects (which supersede condition data)				
10E-1	4	160-164	4	Low		None	Low	2 Bridge (Chandler Blvd UP and Wild Horse Pass Blvd TI UP)	1	
10E-2	20	164-184	10	Low		None	Low		6	Structures with a 5 Rating: Riggs Rd TI (MP 167.47); Gila River Br EB OP (MP 173.12), Gila River Br WB OP (MP 173.12), and Seed Farm Rd (MP 179.39)
10E-3	14	184-198	7	None		None	None	1 Bridge (Earley Rd UP)	0	
10E-4	20	198-218	19	Low	Drain Channel Br EB OP (#908) (MP 209.85), Drain Channel Br WB OP (#1104) (MP 209.85), Hwy 84 TI OP EB (#958) (MP 210.97), Hwy 84 TI OP WB (#959) (MP 210.97), Picacho 5 th St OP EB (#1087) (MP 211.34), Picacho 5 th St OP WB (#1088) (MP 211.34), and E Picacho TI OP EB (#793) (MP 212.21)	None	Low	3 Bridges (Battaglia Rd UP, Drain Channel Br WB OP, and E Picacho TI OP EB)	6	Structures with a 5 Rating: Hwy 84 TI OP EB (MP 198.07), Sunland Gin Rd TI UP (MP 200.12), Battaglia Rd UP (MP 205.45), E Picacho TI OP WB (MP 212.21)
10E-5	18	218-236	4	Medium	Red Rock TI OP (#592) (MP 226.45) and Pinal Air Park TI UP (#771) (MP 232.02)	None	Medium	2 Bridge (Red Rock TI UP and Pinal Air Park TI UP)	0	
10E-6	10	236-246	11	Low		None	Low	1 Bridge (Tangerine TI OP WB)	2	Structures with a 5 Rating: Marana OP TI WB (MP 236.42); Note: Marana bridge identified for replacement in Final DCR (2014)
10E-7	9	246-255	15	Medium	Ina Road TI OP EB (#866) (MP 248.72), Ina Road (#867) (MP 248.72), and Ruthrauff Rd TI OP EB (#872) (MP 252.43)	None	Medium	4 Bridges (Ina Rd TI OP EB, Ina Rd TI OP WB, Sunset Rd TI OP EB, and Ruthrauff Rd TI OP EB)	5	Structures with a 5 Rating: Cortaro Rd TI OP EB (MP 246.06), Cortaro Rd TI OP WB (MP 246.06), Orange Grove TI OP EB (MP 250.04), Orange Grove TI OP WB (MP 250.04), Rillito Creek EB OP (MP 250.66), Sunset Rd TI OP EB (MP 251.18), Ruthrauff Rd TI OP WB (MP 252.43) Notes: Ina EB and WB, Orange Grove EB and WB, Rillito Creek EB, Sunset and Ruthrauff EB and WB identified for replacement in Final DCR (2013); Cortaro bridge identified for replacement in Final DCR (2014)

Table 6: Final Bridge Needs (Step 2) (continued)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Initial Need	Need Adjustments		Final Need	Historical Review	# Functionally Obsolete Bridges	Comments
					Hot Spots (Rating of 4 or multiple 5's)	Previous Projects (which supersede condition data)				
10E-8	7	255-262	15	Low		None	Low	1 Bridge (Park Ave TI OP EB)	0	Structures with a 5 Rating: Park Ave TI OP EB (MP 261.72)
10E-9	12	262-274	26	Medium	Ajo Way OP EB (#1107) (MP 262.44), Ajo Way WB (#1108) (MP 262.44), Kino Pkwy TI UP NB (#1162) (MP 262.53), Country Club OP EB (#1111) (MP 263.82), Earp Wash Trib Br EB OP (#1044) (MP 267.65), Earp Wash Trib Br WB (#1045) (MP 267.65), Craycroft TI OP EB (#594) (MP 268.08), Craycroft TI OP WB (#595) (MP 268.08), Wilmot TI OP EB (#596) (MP 269.36), and Wilmot TI OP WB (#597) (MP 269.36)	None	Medium	13 Bridges (Ajo Way OP EB, Ajo Way OP WB, Kino Pkwy TI UP NB, Kino Pkwy TI UP SB, Diversion Chnl Br WB OP, Country Club OP EB, Palo Verde TI OP EB, Earp Wash Trib Br EB OP, Earp Wash Trib Br WB OP, Wilmot Rd TI OP EB, Wilmot Rd TI OP WB, Kolb Rd TI UP, and Rita Rd TI UP)	3	Structures with a 5 Rating: Kino Pkwy TI UP SB (MP 262.53), Country Club OP WB (MP 263.82), Palo Verde TI OP EB (MP 264.37), Palo Verde TI OP WB (MP 264.37), Kolb Rd TI UP (MP 270.58), Rita Rd TI UP (MP 273.14) Notes: Kino Pkwy NB and SB Deck Rehabilitation Construction programmed for FY 18, Craycroft EB and WB and Wilmot EB and WB Deck Rehabilitation Construction programmed for FY 17 for both
10E-10	6	274-280	5	Medium		None	Medium		3	Structures with a 5 Rating: Wash Bridge EB OP (MP 277.46), Vail Rd TI UP EB (MP 279.37) Notes: Wash Bridge EB Scour Retrofit and Vail Rd Bridge EB and WB Deck Rehabilitation are tentatively programmed for FY 19
10E-11	12	280-292	6	Low	Mountain View TI UP (#1053) (MP 281.68) and Davidson Canyon Br WB OP (#598) (MP 284.45)	Davidson Canyon Bridge Substructure Replacement	Low	1 Bridge (Mountain View TI UP)	1	Notes: The identified previous projects do not address the initial need for this segment; therefore, the final need was not changed; Mountain View Bridge Deck Rehabilitation is tentatively programmed for FY 19

Table 6: Final Bridge Needs (Step 2) (continued)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Initial Need	Need Adjustments		Final Need	Historical Review	# Functionally Obsolete Bridges	Comments
					Hot Spots (Rating of 4 or multiple 5's)	Previous Projects (which supersede condition data)				
10E-12	23	292-315	22	Low	San Pedro Riv Br EB OP (#1530) (MP 306.75) and San Pedro Riv Br WB OP (#1531) (MP 306.75)	San Pedro River Bridge Deck Rehabilitation & Scour Retrofit	Low	2 Bridges (Mescal Rd TI UP and San Pedro Riv Br EB OP)	3	Structures with a 5 Rating: Amole RR OP EB (MP 292.35), Amole RR OP WB (MP 292.35), Cornfield Canyon BR WB OP (MP 299.14), Pomerene Rd TI OP EB (MP 307.10), Pomerene Rd TI OP WB (MP 307.10), Adams Peak Wash Br WB OP (MP 309.75), Sibyl Rd TI OP EB (MP 312.77), Sibyl Rd TI OP WB (MP 312.77) Notes: The identified previous projects do not address the initial need for this segment; therefore, the final need was not changed; Adams Peak Wash Scour Retrofit is programmed for FY 16.
10E-13	17	315-332	4	High	Cochise TI UP (#518) (MP 331.62)	None	High	1 Bridge (Johnson Rd TI UP)	3	Structures with a 5 Rating: Johnson Rd TI UP (MP 322.60)
10E-14	22	332-354	6	Low	Airport Rd UP (#1114) (MP 339.46)	None	Low	1 Bridge (Stewart Rd UP)	3	Structures with a 5 Rating: W Willcox TI UP (MP 336.90), Stewart Rd UP (MP 344.30), Willcox TI UP (MP 344.51)
10E-15	18	354-372	15	Low	Roberts Farm Rd OP EB (#1231) (MP 363.70), Roberts Farm Rd OP WB (#1232) (MP 363.7), Apache Pass Rd OP EB (#1233) (MP 364.79), and Apache Pass Rd OP WB (#1234) (MP 366.79)	None	Low		2	Structures with a 5 Rating: US 191 TI UP (MP 355.97)
10E-16	20	372-392	12	Low		None	Low	1 Bridge (W San Simon TI UP)	3	Structures with a 5 Rating: San Simon Riv Br EB OP (MP 381.68), San Simon Riv WB OP (MP 381.68), Island Wash Br WB OP (MP 389.38) Notes: Island Wash Scour Retrofit is programmed for FY 2018

Figure 6: Bridge History

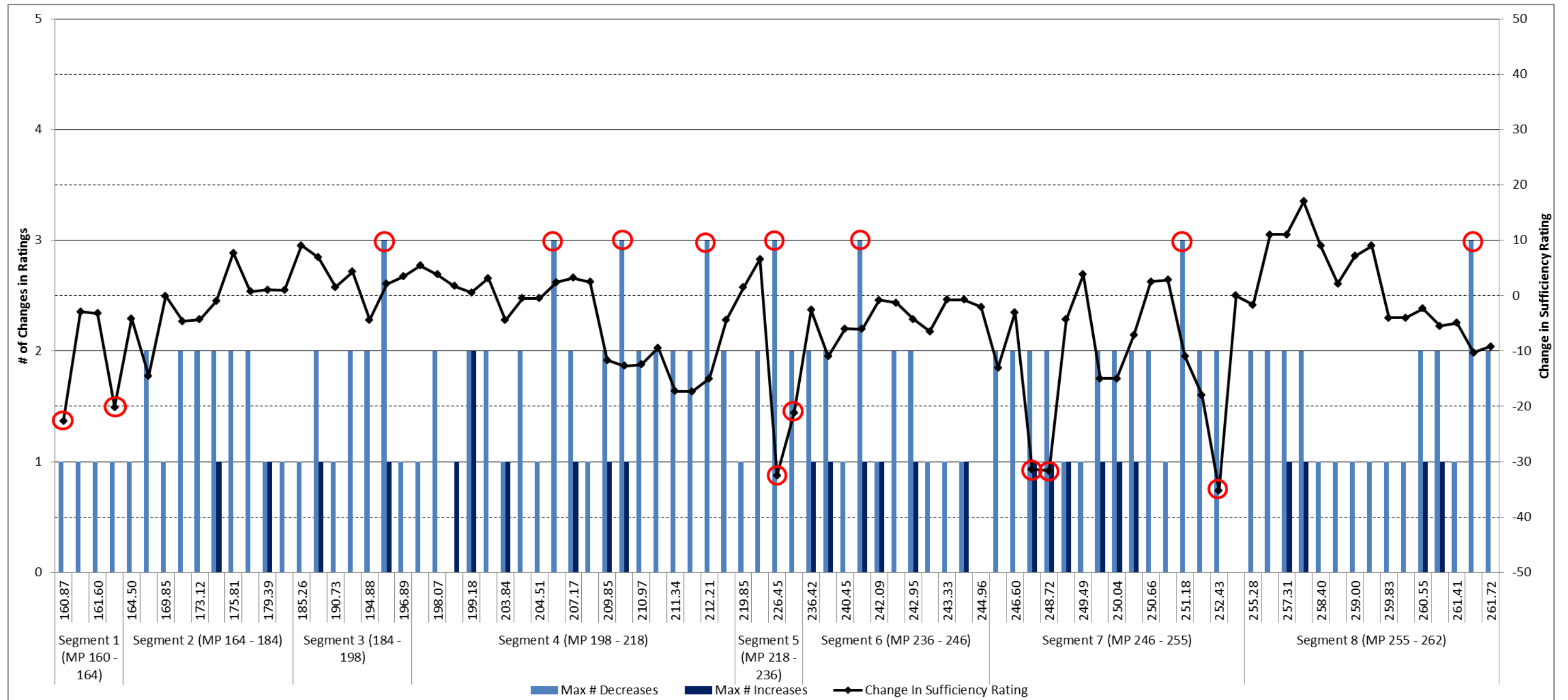
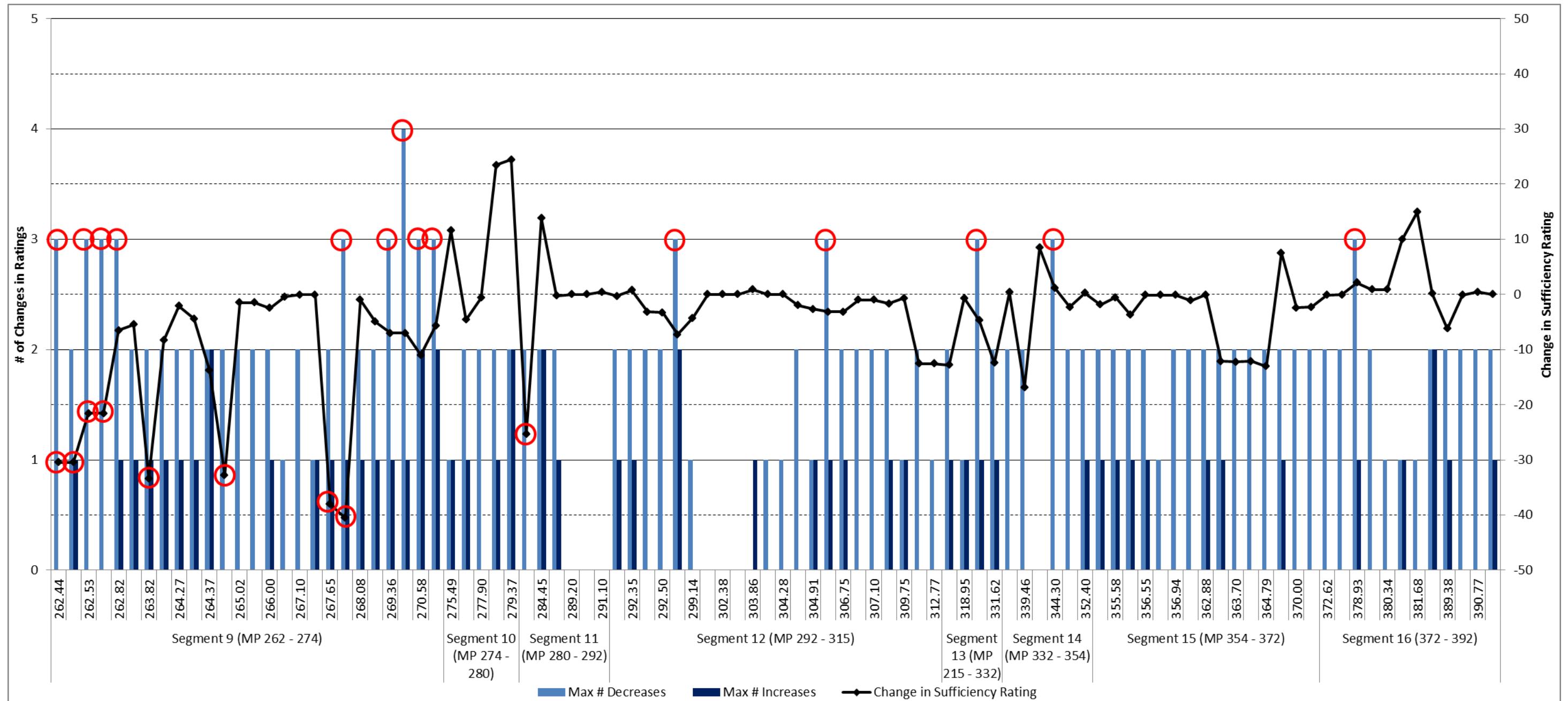


Figure 6: Bridge History (continued)



○ Identifies the bridge indicated is of concern from a historical ratings perspective

Maximum # Decreases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating decreased from 1997 to 2014. (Higher number could indicate a more dramatic decline in the performance of the bridge)

Maximum # Increases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating increased from 1997 to 2014. (Higher number could indicate a higher level of investment)

Change in Sufficiency Rating: Cumulative change in Sufficiency Rating from 1997 to 2014. (Bigger negative number could indicate a more dramatic decline in the performance of the bridge)

Table 7: Bridge Needs Contributing Factors (Step 3)

Segment	Segment Length (Miles)	Segment Mileposts (MP)	Number of Bridges in Segment	# Functionally Obsolete Bridges	Final Need	Contributing Factors			Comments
						Bridge	Current Ratings	Historical Review	
10E-1	4	160-164	4	1	Low	Chandler Blvd UP (#2721) (MP 160.77)	No current ratings less than 6	Identified in historical review	
						Wild Horse Pass Blvd TI OP (#2612) (MP 162.54)	No current ratings less than 6	Identified in historical review	
10E-2	20	164-184	10	6	Low	Riggs Rd TI UP (#1148) (MP 167.47)	Current Substructure and Structural Evaluation Ratings of 5	Not identified in historical review	
						Gila River Br EB OP (#1085) (MP 173.12)	Current Deck Rating of 5	Not identified in historical review	Southcentral and Central Districts inquired about the Gila River Bridge during consultations; in response the most recent bridge ratings were requested.
						Gila River Br WB OP (#1086) (MP 173.12)	Current Deck Rating of 5	Not identified in historical review	
						Seed Farm Rd UP (#1216) (MP 179.39)	Current Substructure and Structural Evaluation Ratings of 5	Not identified in historical review	
10E-3	14	184-198	7	0	None	Earley Rd UP (#1158) (MP 195.89)	No current ratings less than 6	Identified in historical review	
10E-4	20	198-218	19	6	Low	Hwy 84 TI OP EB (#939) (MP 198.07)	Current Deck Rating of 5	Not identified in historical review	
						Sunland Gin Rd TI UP (#941) (MP 200.12)	Current Deck Rating of 5	Not identified in historical review	Likely to be replaced to facilitate mainline widening; identified in DCR 2010
						Battaglia Rd UP (#943) (MP 205.45)	Current Deck Rating of 5	Identified in historical review	
						Drain Channel Br EB OP (#908) (MP 209.85)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Not identified in historical review	
						Drain Channel Br WB OP (#1104) (MP 209.85)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Identified in historical review	
						Hwy 84 TI OP EB (#958) (MP 210.97)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Not identified in historical review	
						Hwy 84 TI OP WB (#959) (MP 210.97)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Not identified in historical review	

Table 7: Bridge Needs Contributing Factors (Step 3) (continued)

Segment	Segment Length (Miles)	Segment Mileposts (MP)	Number of Bridges in Segment	# Functionally Obsolete Bridges	Final Need	Contributing Factors			Comments
						Bridge	Current Ratings	Historical Review	
10E-4	20	198-218	19	6	Low	Picacho 5 th St OP EB (#1087) (MP 211.34)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Not identified in historical review	
						Picacho 5 th St OP WB (#1088) (MP 211.34)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Not identified in historical review	
						E Picacho TI OP EB (#793) (MP 212.21)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Identified in historical review	
						E Picacho TI OP WB (#794) (MP 212.21)	Current Deck and Structural Evaluation Ratings of 5	Not identified in historical review	
10E-5	18	218-236	4	0	Medium	Red Rock TI UP (#592) (MP 226.45)	Current Deck Rating of 4 and Substructure and Structural Evaluation Ratings of 5	Identified in historical review	
						Pinal Air Park TI OP (#771) (MP 232.02)	Current Substructure and Structural Evaluation Ratings of 5	Not identified in historical review	
10E-6	10	236-246	11	2	Low	Marana OP TI WB (#774) (MP 236.42)	Current Substructure and Structural Evaluation Ratings of 5	Not identified in historical review	
						Tangerine TI OP WB (#961) (MP 240.45)	No current ratings less than 6	Identified in historical review	
10E-7	9	246-255	15	5	Medium	Cortaro Rd TI OP EB (#864) (MP 246.60)	Current Deck Rating of 5	Not identified in historical review	Likely to be replaced to facilitate mainline widening; identified in DCR 2014
						Cortaro Rd TI OP WB (#865) (MP 246.60)	Current Substructure and Structural Evaluation Ratings of 5	Not identified in historical review	
						Ina Rd TI OP EB (#866) (MP 248.72)	Current Substructure and Structural Evaluation Ratings of 4	Identified in historical review	Likely to be replaced to facilitate mainline widening; identified in DCR 2013
						Ina Rd TI OP WB (#867) (MP 248.72)	Current Substructure and Structural Evaluation Ratings of 4	Identified in historical review	
						Orange Grove TI OP EB (#868) (MP 250.04)	Current Substructure and Structural Evaluation Ratings of 5	Not identified in historical review	
						Orange Grove TI OP WB (#869) (MP 250.04)	Current Substructure and Structural Evaluation Ratings of 5	Not identified in historical review	

Table 7: Bridge Needs Contributing Factors (Step 3) (continued)

Segment	Segment Length (Miles)	Segment Mileposts (MP)	Number of Bridges in Segment	# Functionally Obsolete Bridges	Final Need	Contributing Factors			Comments
						Bridge	Current Ratings	Historical Review	
10E-7	9	246-255	15	5	Medium	Rillito Creek Br EB OP (#391) (MP 250.66)	Current Structural Evaluation Rating of 5	Not Identified in historical review	Likely to be replaced to facilitate mainline widening; identified in DCR 2013
						Sunset Rd TI OP EB (#870) (MP 251.18)	Current Substructure and Structural Evaluation Ratings of 5	Identified in historical review	
						Ruthrauff Rd TI OP EB (#872) (MP 252.43)	Current Substructure and Structural Evaluation Ratings of 4	Identified in historical review	
						Ruthrauff Rd TI OP WB (#873) (MP 252.43)	Current Substructure and Structural Evaluation Ratings of 5	Not identified in historical review	
10E-8	7	255-262	15	0	Low	Park Ave TI OP EB (#2162) (MP 261.72)	Current Deck Rating of 5	Identified in historical review	
10E-9	12	262-274	26	3	Medium	Ajo Way OP EB (#1107) (MP 262.44)	Current Deck Rating of 5 and Substructure and Structural Evaluation Ratings of 4	Identified in historical review	
						Ajo Way OP WB (#1108) (MP 262.44)	Current Deck Rating of 5 and Substructure and Structural Evaluation Ratings of 4	Identified in historical review	Project is programmed in FY 16
						Kino Pkwy TI UP NB (#1162) (MP 262.53)	Current Deck Rating of 4 and Substructure and Structural Evaluation Ratings of 5	Identified in historical review	Project is programmed in FY 16
						Kino Pkwy TI UP SB (#1163) (MP 262.53)	Current Deck Rating of 5	Identified in historical review	
						Diversion Chnl Br WB OP (#1110) (MP 262.82)	No current ratings less than 6	Identified in historical review	
						Country Club OP EB (#1111) (MP 263.82)	Current Substructure and Structural Evaluation Ratings of 4	Identified in historical review	
						Country Club OP WB (#1112) (MP 263.82)	Current Deck Rating of 5	Not identified in historical review	
						Palo Verde TI OP EB (#1219) (MP 264.37)	Current Substructure and Structural Evaluation Ratings of 5	Identified in historical review	
						Palo Verde TI OP WB (#1220) (MP 264.37)	Current Substructure and Structural Evaluation Ratings of 5	Not identified in historical review	

Table 7: Bridge Needs Contributing Factors (Step 3) (continued)

Segment	Segment Length (Miles)	Segment Mileposts (MP)	Number of Bridges in Segment	# Functionally Obsolete Bridges	Final Need	Contributing Factors			Comments
						Bridge	Current Ratings	Historical Review	
10E-9	12	262-274	26	3	Medium	Earp Wash Trib Br EB OP (#1044) (MP 267.65)	Current Deck, Substructure, and Structural Evaluation Ratings of 4	Identified in historical review	
						Earp Wash Trib Br WB OP (#1045) (MP 267.65)	Current Deck, Substructure, and Structural Evaluation Ratings of 4	Identified in historical review	
						Craycroft TI OP EB (#594) (MP 268.08)	Current Deck Rating of 4	Not identified in historical review	Project is programmed in FY 17
						Craycroft TI OP WB (#595) (MP 268.08)	Current Deck Rating of 4	Not identified in historical review	
						Wilmot Rd TI OP EB (#296) (MP 269.36)	Current Deck Rating of 4	Identified in historical review	Project is programmed in FY 17
						Wilmot Rd TI OP WB (#297) (MP 269.36)	Current Deck Rating of 4	Identified in historical review	
						Kolb Rd TI UP (#1823) (MP 270.58)	Current Substructure and Structural Evaluation Ratings of 5	Identified in historical review	
						Rita Rd TI UP (#711) (MP 273.14)	Current Substructure and Structural Evaluation Ratings of 5	Identified in historical review	
10E-10	6	274-280	5	3	Medium	Wash Bridge EB OP (#463) (MP 277.46)	Current Structural Evaluation Rating of 5	Not identified in historical review	Project is tentatively programmed in FY 19
						Vail Rd TI UP EB (#744) (MP 279.37)	Current Deck Rating of 5	Not identified in historical review	Project is tentatively programmed in FY 19
10E-11	12	280-292	6	1	Low	Mountain View TI UP (#1053) (MP 281.68)	Current Deck, Superstructure, and Structural Evaluation Ratings of 5	Identified in historical review	Project is tentatively programmed in FY 19
						Davidson Canyon Br WB OP (#598) (MP 284.45)	Current Deck, Substructure, Superstructure, and Structural Evaluation Ratings of 5	Not identified in historical review	Previous project may have fixed substructure issue
10E-12	23	292-315	22	3	Low	Amole RR OP EB (#485) (MP 292.35)	Current Deck Rating of 5	Not identified in historical review	
						Amole RR OP WB (#784) (MP 292.35)	Current Deck Rating of 5	Not identified in historical review	
						Mescal Rd TI UP (#517) (MP 297.17)	No current ratings of less than 6	Identified in historical review	

Table 7: Bridge Needs Contributing Factors (Step 3) (continued)

Segment	Segment Length (Miles)	Segment Mileposts (MP)	Number of Bridges in Segment	# Functionally Obsolete Bridges	Final Need	Contributing Factors			Comments
						Bridge	Current Ratings	Historical Review	
10E-12	23	292-315	22	3	Low	Cornfield Canyon Br WB OP (#73) (MP 299.14)	Current Structural Evaluation Rating of 5	Not identified in historical review	
						San Pedro Riv Br EB OP (#1530) (MP 306.75)	Current Deck Rating of 4	Identified in historical review	Previous project may have fixed deck issue
						San Pedro Riv Br WB OP (#1531) (MP 306.75)	Current Deck Rating of 4	Not identified in historical review	
						Pomerene Rd TI OP EB (#1673) (MP 307.10)	Current Deck Rating of 5	Not identified in historical review	
						Pomerene Rd TI OP WB (#1674) (MP 307.10)	Current Deck Rating of 5	Not identified in historical review	
						Adams Peak Wash Br WB OP (#1605) (MP 309.75)	Current Deck Rating of 5	Not identified in historical review	Project is programmed in FY 16
						Sibyl Road TI OP EB (#574) (MP 312.77)	Current Structural Evaluation Rating of 5	Not identified in historical review	
						Sibyl Road TI OP WB (#575) (MP 312.77)	Current Structural Evaluation Rating of 5	Not identified in historical review	
10E-13	17	315-332	4	3	High	Johnson Rd TI UP (#511) (MP 322.60)	Current Superstructure and Structural Evaluation Ratings of 5	Identified in historical review	
						Cochise TI UP (#518) (MP 331.62)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Not identified in historical review	
10E-14	22	332-354	6	3	Low	W Willcox TI UP (#1113) (MP 336.90)	Current Deck Rating of 5	Not identified in historical review	
						Airport Rd UP (#1114) (MP 339.46)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Not identified in historical review	
						Stewart Rd UP (#1228) (MP 344.30)	Current Deck Rating of 5	Identified in historical review	
						E Willcox TI UP (#1229) (MP 344.51)	Current Deck Rating of 5	Not identified in historical review	

Table 7: Bridge Needs Contributing Factors (Step 3) (continued)

Segment	Segment Length (Miles)	Segment Mileposts (MP)	Number of Bridges in Segment	# Functionally Obsolete Bridges	Final Need	Contributing Factors			Comments
						Bridge	Current Ratings	Historical Review	
10E-15	18	354-372	15	2	Low	US 191 TI UP (#649) (MP 355.97)	Current Deck Rating of 5	Not identified in historical review	
						Roberts Farm Rd OP EB (#1231) (MP 363.70)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Not identified in historical review	
						Roberts Farm Rd OP WB (#1232) (MP 363.70)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Not identified in historical review	
						Apache Pass Rd OP EB (#1233) (MP 364.79)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Not identified in historical review	
						Apache Pass Rd OP WB (#1234) (MP 364.79)	Current Deck, Substructure, and Structural Evaluation Ratings of 5	Not identified in historical review	
10E-16	20	372-392	12	3	Low	W San Simon TI UP (#1164) (MP 378.93)	No current ratings less than 6	Identified in historical review	
						San Simon Riv Br EB OP (#1167) (MP 381.68)	Current Superstructure and Structural Evaluation Ratings of 5	Not identified in historical review	
						San Simon Riv Br WB OP (#1168) (MP 381.68)	Current Superstructure and Structural Evaluation Ratings of 5	Not identified in historical review	
						Island Wash Br WB OP (#210) (MP 389.38)	Current Structural Evaluation Rating of 5	Not identified in historical review	Project is programmed in FY 18

5.0 MOBILITY PERFORMANCE AREA NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the I-10 East corridor for the Mobility Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

5.1 Step 1: Initial Mobility Needs

The baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the I-10 East corridor were used to determine the initial mobility needs, as described in Section 2.1. The mobility condition data used to calculate baseline performance was provided by ADOT for 2014 for the existing traffic volumes and travel time data, 2014 for bicycle accommodation data, 2035 for future traffic volumes, and 2010-2014 for the closure data.

Step 1 uses the scores for the Mobility Index primary performance measure and six secondary performance measures to determine the level of need for each performance measure by segment. The six secondary performance measures are Future Daily Volume-to-Capacity (V/C), Existing Directional Peak Hour V/C, Directional Closure Extent, Directional Travel Time Index (TTI), Directional Planning Time Index (PTI), and Bicycle Accommodation.

The performance scores, performance objectives, and initial levels of need for each mobility performance measure and for all mobility performance measures combined are shown in **Table 8**.

For the Mobility Index, two segments report a “High” level of need and two report a “Medium” level of need. For the Future Daily V/C, five segments report a “High” level of need and two report a “Medium” level of need. For the Existing Directional Peak Hour V/C, zero segments report a “High” level of need and one segment reports a “Medium” level of need in both directions. For Directional Closure Extent, zero segments report a “High” level of need and two segments report a “Medium” level of need in the eastbound direction. For Directional TTI, zero segments report a “High” or “Medium” level of need. For Directional PTI, two segments report a “High” level of need in both directions and one segment reports a “Medium” level of need in the eastbound direction. For Bicycle Accommodation, no segment reports a “High” or “Medium” level of need. For all mobility performance measures combined, four segments report a “High” level of need and three segments report a “Medium” level of initial need.

5.2 Step 2: Final Mobility Needs

Once the initial mobility needs by segment for the I-10 East corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 9**.

Recently Completed and Under-Construction Mobility Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any

projects completed or under construction after 2014 that have the potential to mitigate a mobility need on a corridor segment.

There are seven segments containing recently completed projects which would supersede the mobility condition data, as shown in **Table 9**. One of the recently completed projects (on Segment 1) partially addresses the identified mobility need for the segment. As such, one adjustment was made to the need level of that segment from a “High” level of need to a “Low” level of need to account for recently completed or under-construction projects.

Planned or Programmed Projects

Information was noted in **Table 9** on mobility-related planned and programmed projects and other issues identified in previous reports in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

Table 8: Initial Mobility Needs (Step 1)

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Mobility Index			Future Daily V/C			Existing Peak Hour V/C					Closure Extent (occurrences/year/mile)				
					Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
											EB	WB		EB	WB	EB	WB		EB	WB
10E-1	160-164	4	Urban	Uninterrupted	0.84	Fair or Better	Medium	0.85	Fair or Better	Medium	0.63	0.63	Fair or Better	None	None	0.65	0.05	Fair or Better	Medium	None
10E-2	164-184	20	Rural	Uninterrupted	0.80	Fair or Better	Medium	0.94	Fair or Better	High	0.57	0.56	Fair or Better	None	None	0.36	0.13	Fair or Better	Low	None
10E-3	184-198	14	Fringe Urban	Uninterrupted	0.52	Fair or Better	None	0.62	Fair or Better	None	0.36	0.36	Fair or Better	None	None	0.16	0.32	Fair or Better	None	None
10E-4	198-218	20	Fringe Urban	Uninterrupted	0.44	Fair or Better	None	0.52	Fair or Better	None	0.33	0.32	Fair or Better	None	None	0.31	0.12	Fair or Better	None	None
10E-5	218-236	18	Rural	Uninterrupted	0.44	Fair or Better	None	0.51	Fair or Better	None	0.32	0.32	Fair or Better	None	None	0.16	0.18	Fair or Better	None	None
10E-6	236-246	10	Fringe Urban	Uninterrupted	0.56	Fair or Better	None	0.66	Fair or Better	None	0.42	0.39	Fair or Better	None	None	0.33	0.28	Fair or Better	None	None
10E-7	246-255	9	Urban	Uninterrupted	1.00	Fair or Better	High	1.15	Fair or Better	High	0.81	0.79	Fair or Better	Low	Low	0.35	0.11	Fair or Better	None	None
10E-8	255-262	7	Urban	Uninterrupted	1.11	Fair or Better	High	1.31	Fair or Better	High	0.87	0.86	Fair or Better	Medium	Medium	0.29	0.23	Fair or Better	None	None
10E-9	262-274	12	Urban	Uninterrupted	0.82	Fair or Better	Low	0.95	Fair or Better	High	0.61	0.64	Fair or Better	None	None	0.52	0.03	Fair or Better	Medium	None
10E-10	274-280	6	Urban	Uninterrupted	0.58	Fair or Better	None	0.68	Fair or Better	None	0.38	0.38	Fair or Better	None	None	0.37	0.33	Fair or Better	Low	None
10E-11	280-292	12	Rural	Uninterrupted	0.69	Fair or Better	Low	0.83	Fair or Better	High	0.47	0.47	Fair or Better	None	None	0.20	0.41	Fair or Better	None	Low
10E-12	292-315	23	Rural	Uninterrupted	0.63	Fair or Better	Low	0.77	Fair or Better	Medium	0.43	0.39	Fair or Better	None	None	0.19	0.11	Fair or Better	None	None
10E-13	315-332	17	Rural	Uninterrupted	0.38	Fair or Better	None	0.47	Fair or Better	None	0.25	0.24	Fair or Better	None	None	0.06	0.15	Fair or Better	None	None
10E-14	332-354	22	Rural	Uninterrupted	0.33	Fair or Better	None	0.41	Fair or Better	None	0.25	0.21	Fair or Better	None	None	0.08	0.12	Fair or Better	None	None
10E-15	354-372	18	Rural	Uninterrupted	0.28	Fair or Better	None	0.35	Fair or Better	None	0.25	0.20	Fair or Better	None	None	0.31	0.03	Fair or Better	None	None
10E-16	372-392	20	Rural	Uninterrupted	0.46	Fair or Better	None	0.57	Fair or Better	None	0.38	0.33	Fair or Better	None	None	0.21	0.07	Fair or Better	None	None
Mobility Emphasis Area?		Yes	Corridor Weighted Average		0.56	Good	Low													

Table 8: Initial Mobility Needs (Step 1) (continued)

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Directional TTI (all vehicles)					Directional PTI (all vehicles)					Bicycle Accommodation			Initial Need
					Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
					EB	WB		EB	WB	EB	WB		EB	WB				
10E-1*	160-164	4	Urban	Uninterrupted	1.20	1.24	Fair or Better	None	Low	3.25	3.86	Fair or Better	High	High	91%	Fair or Better	None	High
10E-2*	164-184	20	Rural	Uninterrupted	1.09	1.08	Fair or Better	None	None	1.22	1.22	Fair or Better	None	None	100%	Fair or Better	None	High
10E-3*	184-198	14	Fringe Urban	Uninterrupted	1.07	1.08	Fair or Better	None	None	1.20	1.22	Fair or Better	None	None	100%	Fair or Better	None	None
10E-4*	198-218	20	Fringe Urban	Uninterrupted	1.08	1.09	Fair or Better	None	None	1.24	1.27	Fair or Better	None	None	99%	Fair or Better	None	None
10E-5*	218-236	18	Rural	Uninterrupted	1.05	1.07	Fair or Better	None	None	1.21	1.23	Fair or Better	None	None	99%	Fair or Better	None	None
10E-6*	236-246	10	Fringe Urban	Uninterrupted	1.07	1.09	Fair or Better	None	None	1.20	1.20	Fair or Better	None	None	100%	Fair or Better	None	None
10E-7*	246-255	9	Urban	Uninterrupted	1.06	1.04	Fair or Better	None	None	1.63	1.26	Fair or Better	High	None	100%	Fair or Better	None	High
10E-8*	255-262	7	Urban	Uninterrupted	1.06	1.07	Fair or Better	None	None	1.27	1.74	Fair or Better	None	High	100%	Fair or Better	None	High
10E-9*	262-274	12	Urban	Uninterrupted	1.05	1.03	Fair or Better	None	None	1.23	1.24	Fair or Better	None	None	99%	Fair or Better	None	Medium
10E-10	274-280	6	Urban	Uninterrupted	1.09	1.07	Fair or Better	None	None	1.24	1.25	Fair or Better	None	None	98%	Fair or Better	None	Low
10E-11	280-292	12	Rural	Uninterrupted	1.15	1.07	Fair or Better	None	None	1.48	1.23	Fair or Better	Medium	None	94%	Fair or Better	None	Medium
10E-12	292-315	23	Rural	Uninterrupted	1.10	1.13	Fair or Better	None	None	1.29	1.39	Fair or Better	None	Low	100%	Fair or Better	None	Medium
10E-13	315-332	17	Rural	Uninterrupted	1.16	1.12	Fair or Better	None	None	1.43	1.38	Fair or Better	Low	Low	100%	Fair or Better	None	Low
10E-14	332-354	22	Rural	Uninterrupted	1.09	1.11	Fair or Better	None	None	1.37	1.40	Fair or Better	Low	Low	100%	Fair or Better	None	Low
10E-15	354-372	18	Rural	Uninterrupted	1.08	1.09	Fair or Better	None	None	1.20	1.21	Fair or Better	None	None	99%	Fair or Better	None	None
10E-16	372-392	20	Rural	Uninterrupted	1.11	1.10	Fair or Better	None	None	1.32	1.28	Fair or Better	None	None	99%	Fair or Better	None	None

*Bicyclists are prohibited per ADOT’s Traffic Engineering Guidelines and Processes, Section 1030, Table 1030-A, (June 2015)

Table 9: Final Mobility Needs (Step 2)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments	Final Need	Planned and Programmed Future Projects
				Recent Projects Since 2014		
10E-1	160-164	4	High	Roadway widening (MP 162-164) and New DMS EB & WB (MP 163.5)	Low	Programmed: Construct HOV and General Purpose Lane SR 202L (Santan) to Riggs Rd (MP 161-164)
10E-2	164-184	20	High	Paving Project (MP 173-175)	High	Programmed: Construct HOV and General Purpose Lane SR 202L (Santan) to Riggs Rd (MP 164-167) and Sacaton Rest Area Rehabilitation (MP 183) Additional future planned projects or recommendations include: New DMS at MP 167.5 WB, MP 174 EB, and MP 182 EB and WB
10E-3	184-198	14	None	None	None	Programmed: Widen roadway to six lanes (MP 196-198) Additional future planned projects or recommendations include: New DMS at MP 191 EB
10E-4	198-218	20	None	None	None	Programmed: WB I-10 Ramp to WB I-8 Improvements (MP 199) and widen roadway to six lanes (MP 198-200 & MP 209-213) Additional future planned projects or recommendations include: New DMS at MP 217 WB
10E-5	218-236	18	None	None	None	Additional future planned projects or recommendations include: New DMS at MP 224 EB
10E-6	236-246	10	None	None	None	Additional future planned projects or recommendations include: Widen roadway and reconstruct TIs from Tangerine to Cortaro (MP 240-246) and New DMS at MP 243 EB and MP 245 EB
10E-7	246-255	9	High	New DMS EB & WB (MP 254)	High	Programmed: Reconstruct TIs & Mainline from Ina Rd to Ruthrauff Rd (MP 248-252) Additional future planned projects or recommendations include: New DMS at MP 247.2 EB, MP 248 WB and MP 251 WB
10E-8	255-262	7	High	None	High	Additional future planned projects or recommendations include: Reconstruct Park Ave TI (MP 262)
10E-9	262-274	12	Medium	None	Medium	Additional future planned projects or recommendations include: Reconstruct Kino Pkwy TI (MP 263), Construct Country Club TI) MP 264, Construct Wilmot Rd TI (MP 269) and New DMS at MP 266 EB and MP 266.1 WB
10E-10	274-280	6	Low	None	Low	Additional future planned projects or recommendations include: Reconstruct Houghton Rd TI (MP 275)
10E-11	280-292	12	Medium	Paving Project (MP 281-288)	Medium	Additional future planned projects or recommendations include: Climbing Lane MP 286-291 EB (Tier 2)
10E-12	292-315	23	Medium	Paving Project (MP 292-301)	Medium	Additional future planned projects or recommendations include: Climbing Lane MP 302-306 WB (Tier 1) and MP 309-311 (Tier 3)
10E-13	315-332	17	Low	Texas Canyon Rest Area Preservation (MP 320)	Low	Programmed: Rockfall Mitigation Dragoon Rd to Johnson Rd (MP 320) Additional future planned projects or recommendations include: New DMS MP 330 WB and Climbing Lane MP 315-317 (Tier 3)

Table 9: Final Mobility Needs (Step 2) (continued)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments	Final Need	Planned and Programmed Future Projects
				Recent Projects Since 2014		
10E-14	332-354	22	Low	None	Low	Additional future planned projects or recommendations include: New DMS MP 343 WB
10E-15	354-372	18	None	None	None	Programmed: Pavement Preservation on I-10 and I-10B (MP 363-368) Additional future planned projects or recommendations include: New DMS MP 360.2 WB
10E-16	372-392	20	None	San Simon Rest Area Preservation (MP 388)	None	None

5.3 Step 3: Mobility Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors include:

- Roadway variables
- Traffic variables
- Relevant freight-related existing infrastructure
- Closure type
- Non-actionable conditions

Roadway Variables

Roadway variables include functional classification, environmental type (e.g., urban, rural), terrain, number of lanes, speed limit, presence of auxiliary lanes, if a roadway is divided or non-divided, and how often passing is not allowed. These variables are described in more detail below:

- Functional classification indicates if a roadway is an interstate, state highway, or arterial. Capacity equations and parameters differ depending on a roadway’s functional classification.
- Environmental type refers to how developed the land is adjacent to the roadway. Environmental types include urban, fringe urban, and rural. Capacity thresholds differ depending on the environmental type as higher congestion levels are more acceptable in urbanized areas than in rural areas.
- Terrain (described as level, rolling, or mountainous) indicates the general roadway grade, which influences how quickly vehicles can accelerate or decelerate or maintain a constant speed.
- The number of lanes in each direction indicates how many general purpose through lanes exist.
- The speed limit indicates the posted speed limit.
- The presence of auxiliary lanes for turning, weaving, or passing can improve mobility performance by maintaining more consistent speeds in mainline through lanes.
- A roadway is considered divided if it has a raised or depressed median separating the directions of traffic that cannot easily be traversed. A roadway with a painted paved median is considered a non-divided roadway. Dividing a roadway generally increases the roadway capacity.
- The presence of no-passing zones restricts the movement of vehicles around slower-moving vehicles.

Traffic Variables

Traffic variables include existing and future level of service (LOS), percent (%) trucks, and the buffer index (difference between PTI and TTI). The existing and future LOS, percentage of trucks,

and buffer index can indicate how well a corridor is performing in terms of overall mobility and why certain segments of a corridor may be performing worse than others.

Existing and Future LOS

The existing and future LOS provide a letter “grade” between “A” and “F” for mobility that is generally reflective of Existing and Future V/C calculations. LOS values of “A”, “B”, and “C” are generally considered highly acceptable. A LOS value of “D” is generally considered moderately acceptable. LOS values of “E” and “F” are generally considered unacceptable.

Truck Traffic

The amount of truck traffic in a given segment of the corridor can be represented as a percentage of the overall total traffic volume for that specific segment. The truck volume on a corridor can impact overall mobility based on truck travel speed, corridor grades, required inspection points and number of lanes.

Buffer Index

The Buffer Index is calculated by subtracting the segment level TTI value (ratio of peak hour speed to free flow speed) from the segment level PTI value (95th percentile speed). The TTI and PTI values were determined in Working Paper 2. The buffer index expresses the amount of extra time necessary to be on-time 95 percent of the time for any given trip. This calculation provides information on the reliability of a corridor.

Mobility-Related Infrastructure

Mobility-related infrastructure refers to devices or features at specific locations that influence mobility performance. Examples include dynamic message signs (DMS), passing lanes, climbing lanes, ports of entry (POE), rest areas, and parking areas.

Closure Type

The relative frequency of types of closures within each segment helps indicate potential causes of mobility-related needs. Closure types consist of closures due to an incident/crash, obstruction/hazard, or weather condition. The number of each type of closure and the corresponding percentage of all closures that are of each type are noted.

Non-Actionable Conditions

Non-actionable conditions are features or characteristics that result in poor mobility performance that cannot be addressed through an engineered solution. Examples include border patrol checkpoints that require all vehicles to slow down or stop for inspection.

Mobility Needs Contributing Factors

Table 10 summarizes the potential contributing factors to mobility needs on the I-10 East corridor.

Table 10: Mobility Needs Contributing Factors (Step 3)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables								Traffic Variables					Relevant Mobility Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Speed Limit	Aux Lanes	Divided/ Non-Divided	% No Passing	Existing LOS	Future 2035 LOS	% Trucks	NB Buffer Index (PTI-TTI)	SB Buffer Index (PTI-TTI)	
10E-1	160-164	4	Low	Interstate	Urban	Level	2-3	65	Yes	Divided	0%	A-C	D	14%	2.06	2.62	DMS MP 163.5
10E-2	164-184	20	High	Interstate	Rural	Level	2	65-75	No	Divided	0%	C	E	14%	0.13	0.14	Rest Area MP 183
10E-3	184-198	14	None	Interstate	Fringe Urban	Level	2-3	75	No	Divided	0%	A-C	A-C	12%	0.13	0.14	DMS MP 195.6
10E-4	198-218	20	None	Interstate	Fringe Urban	Level	2-3	75	Yes	Divided	0%	A-C	A-C	21%	0.16	0.18	DMS MP 205.2
10E-5	218-236	18	None	Interstate	Rural	Level	3	75	No	Divided	0%	A-C	A/B	21%	0.16	0.16	None
10E-6	236-246	10	None	Interstate	Fringe Urban	Level	3	75	No	Divided	0%	A-C	A-C	15%	0.13	0.12	DMS MP 237.2 & MP 243.3
10E-7	246-255	9	High	Interstate	Urban	Level	3	65-75	Yes	Divided	0%	D	E	12%	0.56	0.22	DMS MP 249.4 & MP 254
10E-8	255-262	7	High	Interstate	Urban	Level	3-4	65	Yes	Divided	0%	D	E	12%	0.20	0.67	DMS MP 257.3, MP 257.6, & MP 261.8
10E-9	262-274	12	Medium	Interstate	Urban	Level	2-3	65-75	No	Divided	0%	A-C	E	15%	0.18	0.20	DMS MP 263.2 & MP 270
10E-10	274-280	6	Low	Interstate	Urban	Level	2	75	No	Divided	0%	A-C	A-C	19%	0.15	0.18	None
10E-11	280-292	12	Medium	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A/B	D	21%	0.34	0.17	DMS MP 280.8 & MP 282.5
10E-12	292-315	23	Medium	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A/B	D	30%	0.20	0.26	DMS 300.6 & 308.8
10E-13	315-332	17	Low	Interstate	Rural	Rolling	2	75	No	Divided	0%	A/B	A/B	39%	0.28	0.26	Rest Area MP 320
10E-14	332-354	22	Low	Interstate	Rural	Rolling	2	75	No	Divided	0%	A/B	A/B	37%	0.28	0.29	DMS MP 347.9
10E-15	354-372	18	None	Interstate	Rural	Rolling	2	75	No	Divided	0%	A/B	A/B	38%	0.12	0.12	DMS MP 362.2
10E-16	372-392	20	None	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A/B	C	39%	0.21	0.18	DMS MP 385.2; POE/Weigh Station MP 383; Rest Area MP 388

Table 10: Mobility Needs Contributing Factors (Step 3) (continued)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total Number of Closures	# Incidents/Accidents	% Incidents/Accidents	# Obstructions/Hazards	% Obstructions/Hazards	# Weather Related	% Weather Related			
10E-1	160-164	4	Low	12	12	100%	0	0%	0	0%	None	Programmed: construct HOV and general purpose lane SR 202L (Santan) to Riggs Rd (MP 161-164)	Percent of closures due to Incidents/Accidents above statewide average
10E-2	164-184	20	High	35	35	100%	0	0%	0	0%	None	Programmed: construct HOV and general purpose lane SR 202L (Santan) to Riggs Rd (MP 164-167) and Sacaton Rest Area rehabilitation (MP 183) Additional future planned projects or recommendations include: new DMS at MP 167.5 WB, MP 174 EB, and MP 182 EB and WB	Percent of closures due to Incidents/Accidents above statewide average
10E-3	184-198	14	None	33	33	100%	0	0%	0	0%	None	Programmed: widen roadway to six lanes (MP 196-198) Additional future planned projects or recommendations include: new DMS at MP 191 EB	Percent of closures due to Incidents/Accidents above statewide average
10E-4	198-218	20	None	28	27	96%	0	0%	1	4%	None	Programmed: WB I-10 Ramp to WB I-8 Improvements (MP 199) and widen roadway to six lanes (MP 198-200 & MP 209-213) Additional future planned projects or recommendations include: new DMS at MP 217 WB	Percent of closures due to Incidents/Accidents and weather above statewide average -One closure due to severe weather warning
10E-5	218-236	18	None	21	21	100%	0	0%	0	0%	None	Additional future planned projects or recommendations include: new DMS at MP 224 EB	Percent of closures due to Incidents/Accidents above statewide average
10E-6	236-246	10	None	24	24	100%	0	0%	0	0%	None	Additional future planned projects or recommendations include: widen roadway and reconstruct TIs from Tangerine to Cortaro (MP 240-246) and new DMS at MP 243 EB and MP 245 EB	Percent of closures due to Incidents/Accidents above statewide average
10E-7	246-255	9	High	19	18	95%	1	5%	0	0%	None	Programmed: Reconstruct TIs & Mainline from Ina Rd to Ruthrauff Rd (MP 248-252) Additional future planned projects or recommendations include: new DMS at MP 247.2 EB, MP 248 WB and MP 251 WB	Percent of closures due to Obstructions/Hazards above statewide average One closure due to flooding
10E-8	255-262	7	High	18	18	100%	0	0%	0	0%	None	Additional future planned projects or recommendations include: Reconstruct Park Ave TI (MP 262)	Percent of closures due to Incidents/Accidents above statewide average
10E-9	262-274	12	Medium	29	29	100%	0	0%	0	0%	None	Additional future planned projects or recommendations include: reconstruct Kino Pkwy TI (MP 263), construct Country Club TI) MP 264, construct Wilmot Rd TI (MP 269) and new DMS at MP 266 EB and MP 266.1 WB	Percent of closures due to Incidents/Accidents above statewide average

Table 10: Mobility Needs Contributing Factors (Step 3) (continued)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total Number of Closures	# Incidents/Accidents	% Incidents/Accidents	# Obstructions/Hazards	% Obstructions/Hazards	# Weather Related	% Weather Related			
10E-10	274-280	6	Low	21	21	100%	0	0%	0	0%	None	Additional future planned projects or recommendations include: reconstruct Houghton Rd TI (MP 275)	Percent of closures due to Incidents/Accidents above statewide average
10E-11	280-292	12	Medium	27	27	100%	0	0%	0	0%	None	Additional future planned projects or recommendations include: climbing lane MP 286-291 EB (Tier 2)	Percent of closures due to Incidents/Accidents above statewide average
10E-12	292-315	23	Medium	31	30	97%	1	3%	0	0%	None	Additional future planned projects or recommendations include: climbing lane MP 302-306 WB (Tier 1) and MP 309-311 (Tier 3)	Percent of closures due to Incidents/Accidents and Obstruction/Hazards above statewide average One closure due to brush fire
10E-13	315-332	17	Low	18	18	100%	0	0%	0	0%	None	Programmed: Rockfall Mitigation Dragoon Rd to Johnson Rd (MP 316-322) Additional future planned projects or recommendations include: new DMS MP 330 WB and climbing lane MP 315-317 (Tier 3)	Percent of closures due to Incidents/Accidents above statewide average
10E-14	332-354	22	Low	14	14	100%	0	0%	0	0%	None	Additional future planned projects or recommendations include: new DMS MP 343 WB	Percent of closures due to Incidents/Accidents above statewide average
10E-15	354-372	18	None	15	14	93%	1	7%	0	0%	None	Programmed: pavement preservation on I-10 and I-10B (MP 363-368) Additional future planned projects or recommendations include: new DMS MP 360.2 WB	Percent of closures due to Obstruction/Hazards above statewide average One closure due to unknown obstruction or hazard
10E-16	372-392	20	None	10	10	100%	0	0%	0	0%	None	None	Percent of closures due to Incidents/Accidents above statewide average

6.0 SAFETY PERFORMANCE NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the I-10 East corridor for the Safety Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

6.1 Step 1: Initial Safety Needs

The baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the I-10 East corridor were used to determine the initial safety needs, as described in Section 2.1. The safety data used to calculate baseline performance was provided by ADOT for 2010 through 2014.

Step 1 uses the scores for the Safety Index primary performance measure and two of the five secondary safety performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The two secondary performance measures used are the Directional Safety Index and the Strategic Highway Safety Plan (SHSP) Top 5 Emphasis Area Behaviors. The three other secondary safety performance measures (Truck-Involved Crashes, Motorcycle-Involved Crashes, and Non-Motorized Crashes) exhibited small crash sample sizes in their entirety and were not considered in the Safety Performance Area needs assessment (refer to sample size criteria documented in Working Paper 2). Corridor segments that exhibited small crash sample sizes for the SHSP Top 5 Emphasis Area Behaviors were excluded from the safety needs assessment.

The performance scores, performance objectives, and initial levels of need for each safety performance measure and for all safety performance measures combined are shown in **Table 11**.

For the Safety Index, five segments report a “High” level of need and three segments and the corridor overall report a “Medium” level of need. For the secondary Directional Safety Index, six segments report a “High” level of need eastbound and five segments report a “High” level of need westbound, with four eastbound “Medium” level of need and two westbound “Medium” level of need. For the SHSP Top 5 Emphasis Area Behaviors, two segments report “High” and “Medium” need at each level. For Truck-Involved Crashes, six segments report a “High” level of need and three segments report a “Medium” level of need. As mentioned, Motorcycle-Involved Crashes, and Non-Motorized Crashes were not considered in the needs assessment due to small crash sample sizes. For all safety performance measures combined, seven segments report a “High” level of initial need and two segments report a “Medium” level of initial need.

6.2 Step 2: Final Safety Needs

Once the initial safety needs by segment for the I-10 East corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of crash hot spots as well as relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 12**.

Safety Hot Spots

There are 10 segments containing one or more safety hot spots. The location of the safety hot spot is listed in **Table 12**. The safety hot spots are within segments that already have identified initial needs, so no adjustments were made to the need level of the segments to account for the hot spots.

Recently Completed and Under-Construction Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a safety need on a corridor segment.

There are two segments containing a recently completed project that would supersede the safety data, as shown in **Table 12**. This recently completed project did not address the identified safety need for the segments; therefore no changes were made to the level of need for the segments.

Planned or Programmed Projects

Information was noted in **Table 12** on safety-related planned and programmed projects and other issues identified in previous reports in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

Table 11: Initial Safety Needs (Step 1)

Segment	Operating Environment	Segment Length (miles)	Segment Mileposts (MP)	Safety Index			Directional Safety Index					% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors		
				Performance Score	Performance Objective	Level of Need	EB Performance Score	WB Performance Score	Performance Objective	EB Level of Need	WB Level of Need	Performance Score	Performance Objective	Level of Need
10E-1	Urban or Rural 6 Lane Freeway	4	160-164	1.58	Average or Better	High	1.71	1.46	Average or Better	High	High	61%	Average or Better	Medium
10E-2	Rural 4 Lane Freeway with Daily > 25,000	20	164-184	1.03	Average or Better	Low	1.09	0.96	Average or Better	Low	Low	42%	Average or Better	None
10E-3	Urban or Rural 6 Lane Freeway	14	184-198	1.67	Average or Better	High	2.60	0.75	Average or Better	High	None	50%	Average or Better	Low
10E-4	Urban or Rural 6 Lane Freeway	20	198-218	1.10	Average or Better	Medium	0.78	1.42	Average or Better	None	High	26%	Average or Better	None
10E-5	Urban or Rural 6 Lane Freeway	18	218-236	1.06	Average or Better	Low	1.00	1.11	Average or Better	Low	Medium	35%	Average or Better	None
10E-6	Urban or Rural 6 Lane Freeway	10	236-246	1.46	Average or Better	High	1.73	1.19	Average or Better	High	Medium	32%	Average or Better	None
10E-7	Urban or Rural 6 Lane Freeway	9	246-255	0.64	Average or Better	None	1.10	0.18	Average or Better	Medium	None	44%	Average or Better	Low
10E-8	Urban > 6 Lane Freeway	7	255-262	0.92	Average or Better	None	0.88	0.97	Average or Better	None	Low	45%	Average or Better	None
10E-9	Urban 4 Lane Freeway	12	262-274	0.88	Average or Better	None	0.14	1.63	Average or Better	None	High	61%	Average or Better	Medium
10E-10	Urban 4 Lane Freeway	6	274-280	2.21	Average or Better	High	2.39	2.03	Average or Better	High	High	67%	Average or Better	High
10E-11	Rural 4 Lane Freeway with Daily > 25,000	12	280-292	1.21	Average or Better	Medium	1.84	0.59	Average or Better	High	None	43%	Average or Better	None
10E-12	Rural 4 Lane Freeway with Daily < 25,000	23	292-315	1.92	Average or Better	High	1.34	2.49	Average or Better	Medium	High	43%	Average or Better	None
10E-13	Rural 4 Lane Freeway with Daily < 25,000	17	315-332	0.71	Average or Better	None	1.25	0.17	Average or Better	Medium	None	61%	Average or Better	High
10E-14	Rural 4 Lane Freeway with Daily < 25,000	22	332-354	0.73	Average or Better	None	0.68	0.77	Average or Better	None	None	39%	Average or Better	None
10E-15	Rural 4 Lane Freeway with Daily < 25,000	18	354-372	1.21	Average or Better	Medium	1.99	0.43	Average or Better	High	None	27%	Average or Better	None
10E-16	Rural 4 Lane Freeway with Daily < 25,000	20	372-392	0.60	Average or Better	None	1.14	0.07	Average or Better	Medium	None	33%	Average or Better	None
Safety Emphasis Area?		Yes	Corridor Weighted Average	1.13	Above Average	Medium								

Table 11: Initial Safety Needs (Step 1) (continued)

Segment	Operating Environment	Segment Length (miles)	Segment Mileposts (MP)	% of Fatal + Incapacitating Injury Crashes Involving Trucks			% of Fatal + Incapacitating Injury Crashes Involving Motorcycles			% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
10E-1	Urban or Rural 6 Lane Freeway	4	160-164	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
10E-2	Rural 4 Lane Freeway with Daily > 25,000	20	164-184	14%	Average or Better	Medium	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Medium
10E-3	Urban or Rural 6 Lane Freeway	14	184-198	0%	Average or Better	None	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
10E-4	Urban or Rural 6 Lane Freeway	20	198-218	23%	Average or Better	High	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
10E-5	Urban or Rural 6 Lane Freeway	18	218-236	22%	Average or Better	High	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
10E-6	Urban or Rural 6 Lane Freeway	10	236-246	11%	Average or Better	Medium	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
10E-7	Urban or Rural 6 Lane Freeway	9	246-255	4%	Average or Better	None	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
10E-8	Urban > 6 Lane Freeway	7	255-262	15%	Average or Better	High	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
10E-9	Urban 4 Lane Freeway	12	262-274	4%	Average or Better	None	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
10E-10	Urban 4 Lane Freeway	6	274-280	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
10E-11	Rural 4 Lane Freeway with Daily > 25,000	12	280-292	17%	Average or Better	High	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Medium
10E-12	Rural 4 Lane Freeway with Daily < 25,000	23	292-315	11%	Average or Better	None	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
10E-13	Rural 4 Lane Freeway with Daily < 25,000	17	315-332	0%	Average or Better	None	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
10E-14	Rural 4 Lane Freeway with Daily < 25,000	22	332-354	28%	Average or Better	High	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
10E-15	Rural 4 Lane Freeway with Daily < 25,000	18	354-372	27%	Average or Better	High	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
10E-16	Rural 4 Lane Freeway with Daily < 25,000	20	372-392	17%	Average or Better	Medium	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low

Table 12: Final Safety Needs (Step 2)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Hot Spots	Relevant Recently Completed or Under Construction Projects (which supersede performance data)*	Final Need	Comments (may include tentatively programmed projects with potential to address need or other relevant issues identified in previous reports)
10E-1	4	160-164	High	MP 163 WB	None	High	Programmed: New general purpose and HOV lane at MP 161-164
10E-2	20	164-184	Medium	MP 164-166 WB, MP 166-169 EB, MP 167 WB, MP 170 EB, MP 172-174 WB, and MP 183 EB	None	Medium	
10E-3	14	184-198	High	MP 184 EB, MP 185-187 EB, MP 189 EB, and MP 196 EB	None	High	
10E-4	20	198-218	High	MP 213-215 WB	None	High	Programmed: I-8 TI Reconstruction at MP 199
10E-5	18	218-236	Low	None	None	Low	
10E-6	10	236-246	High	None	None	High	
10E-7	9	246-255	Low	MP 248-251 EB and MP 254 WB	None	Low	
10E-8	7	255-262	Low	MP 257 WB	None	Low	
10E-9	12	262-274	Low	MP 262-264 EB	None	Low	Programmed: Kino Pkwy Bridge at MP 262, Craycroft Bridge at MP 268, Wilmot Bridge at MP 269, Park Ave TI Reconstruction at MP 262, Kino Pkwy TI Reconstruction at MP 263, and Construct Country Club Rd TI at MP 264
10E-10	6	274-280	High	MP 274-276 EB and MP 278 WB	None	High	Programmed: Houghton Rd TI Reconstruction at MP 275
10E-11	12	280-292	Medium	None	Superelevation Improvements (MP 281-288)	Medium	Proposed Climbing Lane at MP 286-291 (EB)- Tier 2
10E-12	23	292-315	High	MP 295-297 EB	Superelevation Improvements (MP 292-298)	High	Proposed Climbing Lane at MP 302-306 (WB)- Tier 3 Proposed Climbing Lane at MP 309-311 (EB)- Tier 1
10E-13	17	315-332	Low	MP 317 EB	None	Low	Programmed: Rockfall Mitigation at MP 316-322 Proposed Climbing Lane at MP 315-317 (EB)- Tier 3
10E-14	22	332-354	Low	None	None	Low	
10E-15	18	354-372	High	None	None	High	
10E-16	20	372-392	Low	None	None	Low	

6.3 Step 3: Safety Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors can be derived from:

- Hot spot crash summaries
- Previously completed safety-related projects
- District input on safety concerns
- Segment crash type summaries
- Section 6.2 of the 2010 Highway Safety Manual

Hot Spot Crash Summaries

Crash summaries were developed for each identified crash hot spot to identify observable crash patterns. These crash summaries are based on crashes of all severity levels (not just fatal and incapacitating injury) to provide more information for use in identifying crash patterns.

Previously Completed Safety-Related Projects

Recently completed safety-related projects may provide insight into previously identified contributing factors along the corridor. Some recently completed safety-related projects may already address some of the crash patterns evident in the crash analysis. Other safety-related projects completed before the crash analysis time period (i.e., more than five years old) may have exceeded their respective design life and rehabilitation or replacement could increase their effectiveness. Examples include rumble strips that are worn down or retroreflective materials that have lost their retroreflectivity.

District Input on Safety Concerns

ADOT maintenance personnel provided information on locations where they had observed potential safety needs. Locations were defined by approximate milepost limits and assigned to the appropriate corridor segment. District safety concerns that corroborated the segment crash type summaries or crash hot spots summaries were noted.

Segment Crash Type Summaries

Crash frequencies for each possible crash type descriptor within each of the eight crash type summary categories were summarized for fatal and incapacitating injury crashes for each corridor segment that contained at least five crashes of that crash type descriptor (lower crash totals were not considered to have a sufficient sample size for analysis purposes). For an even more robust data set, crash types for crashes of all severity levels (not just fatal and incapacitating injury) can be reviewed to determine if crash patterns are readily identifiable. If this more detailed analysis is conducted, it is recommended that it only be conducted on segments with “Medium” or “High” levels of need to minimize analysis effort.

The proportional occurrence of each possible crash type descriptor compared to the total number of fatal plus incapacitating injury crashes occurring in that respective segment was also calculated and expressed as a percentage. These segment-level crash type descriptor frequency percentages were then compared with the corresponding statewide crash type descriptor frequency percentages for all state highways with similar operating environments (as defined in

the baseline corridor performance in Working Paper 2). Segment crash type descriptor frequency percentages that exceeded the corresponding statewide frequency percentage were identified as likely contributing factors to the level of need (illustrated with a red font). The crash type descriptors include the following components:

- First Harmful Event Type
 - Collision with Motor Vehicle
 - Overturning
 - Collision with Pedestrian
 - Collision with Pedalcyclist
 - Collision With Animal
 - Collision with Fixed Object
 - Collision with Non-Fixed Object
 - Vehicle Fire or Explosion
 - Other Non-Collision
 - Unknown
- Collision Type
 - Single Vehicle Collisions
 - Angle
 - Left Turn
 - Rear End
 - Head On
 - Sideswipe (same)
 - Sideswipe (opposite)
 - Rear to Side
 - Rear to Rear
 - Other
 - Unknown
- Violation or Behavior Type
 - No Improper Action
 - Speed too Fast for Conditions
 - Exceeded Lawful Speed
 - Failure to Yield Right-of-Way
 - Followed Too Closely
 - Ran Stop Sign
 - Disregarded Traffic Signal
 - Made Improper Turn
 - Drove in Opposing Lane
 - Faulty/Missing Equipment
 - Motorcycle Safety Equipment Use
 - Passed in No Passing Zone
 - Unsafe Lane Change
 - Failure to Keep in Proper Lane

- Other Unsafe Passing
- Inattention/Distraction
- Electronic Communications Device
- Other
- Type of Lighting Conditions
 - Daylight
 - Dawn
 - Dusk
 - Dark-Lighted
 - Dark-Unlighted
 - Dark-Unknown Lighting
- Type of Road Surface Conditions
 - Dry
 - Wet
 - Snow
 - Slush
 - Ice/Frost
 - Water (standing or moving)
 - Sand
 - Mud, Dirt, Gravel
 - Oil
 - Other
 - Unknown
- First Unit Event Description
 - Collision with Animal
 - Collision with Fixed Object
 - Ran Off the Road (Left)
 - Ran Off the Road (Right)
 - Crossed Centerline
 - Crossed Median
 - Collision with Pedestrian
 - Motor Vehicle in Transport
 - Overturn
 - Equipment Failure
 - Collision with Falling Object
 - Other Non-Collision
 - Other Non-Fixed Object
 - Unknown
- Driver Physical Condition
 - Under the Influence of Drugs or Alcohol

- Fatigued/Fell Asleep
- No Apparent Influence
- Had Been Drinking
- Medications
- Illness
- Physical Impairment
- Other
- Unknown
- Safety Device Usage
 - Shoulder and Lap Belt
 - Child Restraint System
 - None Used
 - Helmet Used
 - Air Bag Deployed/Shoulder-Lap Belt
 - Air Bag Deployed
 - Other
 - Unknown
 - Not Applicable
 - Lap Belt
 - Not Reported

Section 6.2 of the 2010 Highway Safety Manual

Section 6.2 of the 2010 Highway Safety Manual (HSM) provides potential contributing factors for corresponding crash types and patterns. Crash patterns within the corridor that match crash patterns in the HSM can reasonably be expected to have similar potential contributing factors to those listed in the HSM.

Safety Needs Contributing Factors

Likely contributing factors were developed based on the information obtained through the hot spot crash summaries, previously completed safety-related projects, District input on safety concerns, segment crash type summaries, and HSM potential contributing factors. These contributing factors provide guidance on the types of solutions that will likely promote improved safety performance.

Table 13 summarizes the likely contributing factors to safety needs on the I-10 East corridor.

Table 13: Safety Needs Contributing Factors (Step 3)

Segment Number		10E-1	10E-2	10E-3	10E-4	10E-5	10E-6
Segment Length (miles)		4	20	14	20	18	10
Segment Milepost (MP)		160 - 164	164 - 184	184 - 198	198 - 218	218 - 236	236 - 246
Final Need		High	Medium	High	High	Low	High
Segment Crash Overview		5 Crashes were fatal 13 Crashes had incapacitating injuries 1 Crashes involve trucks 0 Crashes involve Motorcycles	18 Crashes were fatal 53 Crashes had incapacitating injuries 10 Crashes involve trucks 7 Crashes involve Motorcycles	14 Crashes were fatal 18 Crashes had incapacitating injuries 0 Crashes involve trucks 0 Crashes involve Motorcycles	12 Crashes were fatal 23 Crashes had incapacitating injuries 8 Crashes involve trucks 3 Crashes involve Motorcycles	11 Crashes were fatal 12 Crashes had incapacitating injuries 5 Crashes involve trucks 0 Crashes involve Motorcycles	10 Crashes were fatal 9 Crashes had incapacitating injuries 2 Crashes involve trucks 0 Crashes involve Motorcycles
Segment Crash Summaries (Fatal and Serious Injury Crashes)	First Harmful Event Type	42% Involve Collision with Motor Vehicle 17% Involve Overturning 17% Involve Collision with Pedestrian	43% Involve Overturning 37% Involve Collision with Motor Vehicle 16% Involve Collision with Fixed Object	42% Involve Overturning 32% Involve Collision with Motor Vehicle 16% Involve Collision with Fixed Object	48% Involve Overturning 39% Involve Collision with Motor Vehicle 13% Involve Collision with Fixed Object	52% Involve Collision with Motor Vehicle 22% Involve Overturning 9% Involve Collision with Pedestrian	32% Involve Collision with Motor Vehicle 21% Involve Overturning 16% Involve Collision with Pedestrian
	Collision Type	42% Involve Single Vehicle 33% Involve Rear End 17% Involve Other	57% Involve Single Vehicle 22% Involve Rear End 6% Involve Angle	58% Involve Single Vehicle 16% Involve Sideswipe (same) 11% Involve Other	52% Involve Single Vehicle 30% Involve Rear End 13% Involve Other	35% Involve Single Vehicle 26% Involve Rear End 22% Involve Sideswipe (same)	37% Involve Single Vehicle 37% Involve Other 11% Involve Rear End
	Violation or Behavior	33% Involve Speed too Fast for Conditions 17% Involve Failure to Keep in Proper Lane 17% Involved Inattention/Distracted	39% Involve Speed too Fast for Conditions 18% Involve No Improper Action 12% Involve Other	26% Involve Speed too Fast for Conditions 26% Involve Failure to Keep in Proper Lane 16% Involve Other	35% Involve No Improper Action 26% Involve Speed too Fast for Conditions 13% Involve Unsafe Lane Change	52% Involve Speed too Fast for Conditions 13% Involve Failure to Keep in Proper Lane 9% Involve No Improper Action	26% Involve No Improper Action 26% Involve Unknown 21% Involve Speed too Fast for Conditions
	Lighting Conditions	42% Occur in Daylight Conditions 33% Occur in Dark-Lighted Conditions 17% Occur in Dark-Unlighted Conditions	49% Occur in Daylight Conditions 43% Occur in Dark-Unlighted Conditions 4% Occur in Dark-Lighted Conditions	63% Occur in Daylight Conditions 32% Occur in Dark-Unlighted Conditions 5% Occur in Dark-Lighted Conditions	74% Occur in Daylight Conditions 22% Occur in Dark-Unlighted Conditions 4% Occur in Dusk Conditions	52% Occur in Daylight Conditions 39% Occur in Dark-Unlighted Conditions 9% Occur in Dawn Conditions	53% Occur in Dark-Unlighted Conditions 47% Occur in Daylight Conditions
	Surface Conditions	100% Involve Dry Conditions	98% Involve Dry Conditions 2% Involve Wet Conditions	95% Involve Dry Conditions 5% Involve Wet Conditions	87% Involve Dry Conditions 4% Involve Wet Conditions 4% Involve Mud, Dirt, Gravel	91% Involve Dry Conditions 4% Involve Wet Conditions 4% Involve Water (standing or moving)	95% Involve Dry Conditions 5% Involve Wet Conditions
	First Unit Event	50% Involve a first unit event of Motor Vehicle in Transport 25% Involve a first unit event of Ran Off the Road (Right) 17% Involve a first unit event of Ran Off the Road (Left)	35% Involve a first unit event of Ran Off the Road (Left) 25% Involve a first unit event of Motor Vehicle in Transport 16% Involve a first unit event of Ran Off the Road (Right)	37% Involve a first unit event of Ran Off the Road (Left) 26% Involve a first unit event of Motor Vehicle in Transport 16% Involve a first unit event of Equipment Failure	43% Involve a first unit event of Motor Vehicle in Transport 30% Involve a first unit event of Equipment Failure 13% Involve a first unit event of Ran Off the Road (Left)	48% Involve a first unit event of Motor Vehicle in Transport 13% Involve a first unit event of Ran Off the Road (Right) 13% Involve a first unit event of Ran Off the Road (Right)	37% Involve a first unit event of Motor Vehicle in Transport 16% Involve a first unit event of Ran Off the Road (Left) 16% Involve Equipment Failure
	Driver Physical Condition	42% No Apparent Influence 33% Unknown 25% Under the Influence of Drugs or Alcohol	57% No Apparent Influence 22% Unknown 14% Under the Influence of Drugs or Alcohol	63% No Apparent Influence 21% Under the Influence of Drugs or Alcohol 5% Medications	78% No Apparent Influence 9% Under the Influence of Drugs or Alcohol 9% Under the Influence of Drugs or Alcohol	52% No Apparent Influence 26% Unknown 13% Under the Influence of Drugs or Alcohol	42% No Apparent Influence 37% Unknown 16% Under the Influence of Drugs or Alcohol
	Safety Device Usage	33% None Used 25% Shoulder And Lap Belt Used 17% Unknown	67% Shoulder And Lap Belt Used 22% None Used 6% Air Bag Deployed/Shoulder-Lap Belt	53% Shoulder And Lap Belt Used 26% None Used 11% Air Bag Deployed/Shoulder-Lap Belt	83% Shoulder And Lap Belt Used 4% None Used 4% Helmet Used	65% Shoulder And Lap Belt Used 17% None Used 9% Unknown	42% Shoulder And Lap Belt Used 32% Unknown 11% None Used
Hot Spot Crash Summaries		Hot Spot from MP 163-164 WB: 0 Fatalities and 2 Incapacitating Injuries. All involved rear ending.	Hot Spots from MP 166-169 EB, MP 170-171 EB, MP 183-184 EB, MP 164-166 WB, MP 167-168 WB, and MP 172-174 WB: 8 Fatalities and 29 Incapacitating Injuries. 95% of crashes occurred in dry conditions.	Hot Spots from MP 184-185 EB, MP 185-187 EB, MP 189-190 EB, and MP 196-197: 8 Fatalities and 5 Incapacitating Injuries. 75% occurred in daylight and all but on crash was in dry conditions.	Hot Spot from MP 213-215 WB: 4 Fatalities and 3 Incapacitating Injuries. 50% involved rear ending.	None	None
Previously Completed Safety-Related Projects							
District Interviews/Discussions							
Contributing Factors		- Excessive speed - Poor sign visibility - Pedestrians on roadway - Bicycles on roadway - Driver distraction/inattention - Peak hour congestion	- Excessive speed - Poor nighttime visibility or lighting - Poor sign visibility - Inadequate roadway shoulders - Driver distraction/inattention - Peak hour congestion - Wet pavement condition	- Excessive speed - Poor nighttime visibility or lighting - Poor sign visibility - Driver distraction/inattention - Wet pavement condition	- Excessive speed - Poor nighttime visibility or lighting - Poor sign visibility - Driver distraction/inattention - Peak hour congestion - Wet and muddy pavement condition	- Excessive speed - Poor nighttime visibility or lighting - Poor sign visibility - Inadequate sight distance - Driver distraction/inattention - Peak hour congestion - Standing water and wet condition	- Excessive speed - Poor nighttime visibility or lighting - Poor sign visibility - Inadequate sight distance - Driver distraction/inattention - Peak hour congestion - Wet pavement condition

Table 13: Safety Needs Contributing Factors (Step 3) (continued)

Segment Number		10E-7	10E-8	10E-9	10E-10	10E-11	10E-12
Segment Length (miles)		9	7	12	6	12	23
Segment Milepost (MP)		246 - 255	255 - 262	262 - 274	274 - 280	280 - 292	292 - 315
Final Need		Low	Low	Low	High	Medium	High
Segment Crash Overview		4 Crashes were fatal 21 Crashes had incapacitating injuries 1 Crashes involve trucks 4 Crashes involve Motorcycles	8 Crashes were fatal 12 Crashes had incapacitating injuries 3 Crashes involve trucks 0 Crashes involve Motorcycles	8 Crashes were fatal 15 Crashes had incapacitating injuries 1 Crashes involve trucks 6 Crashes involve Motorcycles	9 Crashes were fatal 9 Crashes had incapacitating injuries 2 Crashes involve trucks 2 Crashes involve Motorcycles	10 Crashes were fatal 20 Crashes had incapacitating injuries 5 Crashes involve trucks 2 Crashes involve Motorcycles	15 Crashes were fatal 22 Crashes had incapacitating injuries 4 Crashes involve trucks 3 Crashes involve Motorcycles
Segment Crash Summaries (Fatal and Serious Injury Crashes)	First Harmful Event Type	46% Involve Overturning 29% Involve Collision with Motor Vehicle 25% Involve Collision with Fixed Object	64% Involve Collision with Motor Vehicle 21% Involve Collision with Pedestrian 7% Involve Overturning	48% Involve Collision with Motor Vehicle 26% Involve Overturning 17% Involve Collision with Fixed Object	44% Involve Overturning 39% Involve Collision with Motor Vehicle 6% Involve Collision with Fixed Object	41% Involve Overturning 26% Involve Collision with Motor Vehicle 22% Involve Collision with Fixed Object	50% Involve Overturning 36% Involve Collision with Motor Vehicle 6% Involve Collision with Pedestrian
	Collision Type	71% Involve Single Vehicle 13% Involve Rear End 8% Involve Angle	50% Involve Rear End 14% Involve Single Vehicle 14% Involve Sideswipe (same)	39% Involve Single Vehicle 26% Involve Rear End 17% Involve Other	50% Involve Single Vehicle 22% Involve Rear End 11% Involve Head On	70% Involve Single Vehicle 11% Involve Rear End 7% Involve Sideswipe (same)	58% Involve Single Vehicle 22% Involve Rear End 8% Involve Other
	Violation or Behavior	54% Involve Speed too Fast for Conditions 38% Involve No Improper Action 4% Involve Inattention/Distracted	43% Involve Speed too Fast for Conditions 14% Involve Failure to Keep in Proper Lane 13% Involve Did Not Use Crosswalk	22% Involve Speed too Fast for Conditions 22% Involve Other 13% Involve Failure to Keep in Proper Lane	17% Involve No Improper Action 17% Involve Speed too Fast for Conditions 17% Involve Drove in Opposing Lane	52% Involve Speed too Fast for Conditions 19% Involve No Improper Action 7% Involve Failure to Keep in Proper Lane	36% Involve Speed too Fast for Conditions 19% Involve No Improper Action 19% Involve Other
	Lighting Conditions	42% Occur in Daylight Conditions 38% Occur in Dark-Lighted Conditions 17% Occur in Dark-Unlighted Conditions	57% Occur in Dark-Lighted Conditions 43% Occur in Daylight Conditions	48% Occur in Daylight Conditions 35% Occur in Dark-Unlighted Conditions 13% Occur in Dark-Lighted Conditions	56% Occur in Dark-Unlighted Conditions 44% Occur in Daylight Conditions	56% Occur in Daylight Conditions 41% Occur in Dark-Unlighted Conditions 4% Occur in Dusk Conditions	78% Occur in Daylight Conditions 19% Occur in Dark-Unlighted Conditions 3% Occur in Dusk Conditions
	Surface Conditions	100% Involve Dry Conditions	100% Involve Dry Conditions	96% Involve Dry Conditions 4% Involve Ice/Frost Conditions	100% Involve Dry Conditions	67% Involve Dry Conditions 30% Involve Wet Conditions 4% Involve Water (standing or moving) Conditions	92% Involve Dry Conditions 8% Involve Wet Conditions
	First Unit Event	38% Involve a first unit event of Motor Vehicle in Transport 21% Involve a first unit event of Ran Off the Road (Right) 17% Involve a first unit event of Ran Off the Road (Left)	79% Involve a first unit event of Motor Vehicle in Transport 21% Involve a first unit event of Ran Off the Road (Right)	48% Involve a first unit event of Motor Vehicle in Transport 30% Involve a first unit event of Ran Off the Road (Left) 9% Involve a first unit event of Ran Off the Road (Right)	39% Involve a first unit event of Motor Vehicle in Transport 33% Involve a first unit event of Ran Off the Road (Left) 11% Involve a first unit event of Ran Off the Road (Right)	33% Involve a first unit event of Ran Off the Road (Left) 26% Involve a first unit event of Motor Vehicle in Transport 22% Involve a first unit event of Ran Off the Road (Right)	42% Involve a first unit event of Motor Vehicle in Transport 22% Involve a first unit event of Ran Off the Road (Left) 17% Involve a first unit event of Ran Off the Road (Right)
	Driver Physical Condition	46% No Apparent Influence 21% Unknown 17% Fatigued/Fell Asleep	50% No Apparent Influence 29% Under the Influence of Drugs or Alcohol 21% Unknown	43% No Apparent Influence 30% Unknown 17% Under the Influence of Drugs or Alcohol	50% No Apparent Influence 28% Under the Influence of Drugs or Alcohol 11% Fatigued/Fell Asleep	56% No Apparent Influence 22% Unknown 11% Fatigued/Fell Asleep	39% No Apparent Influence 33% Unknown 22% Under the Influence of Drugs or Alcohol
	Safety Device Usage	58% Shoulder And Lap Belt Used 21% None Used 8% Not Applicable	50% Shoulder And Lap Belt Used 21% Not Applicable 14% Air Bag Deployed	39% Shoulder And Lap Belt Used 39% None Used 9% Not Applicable	50% Shoulder And Lap Belt Used 33% None Used 6% Air Bag Deployed/Shoulder-Lap Belt	74% Shoulder And Lap Belt Used 15% None Used 7% Unknown	58% Shoulder And Lap Belt Used 19% None Used 6% Helmet Used
Hot Spot Crash Summaries		Hot Spots from MP 248-251 EB and MP 254-255 WB: 3 Fatalities and 12 Incapacitating Injuries. All crashes occurred in dry conditions.	Hot Spot from MP 257-258 WB: 3 Fatalities and 3 Incapacitating Injuries. All crashes occurred in dry conditions.	Hot Spot from MP 262-264 EB: 1 Fatality and 5 Incapacitating Injuries. All crashes occurred in dry conditions.	Hot Spots from MP 274-276 EB and MP 278-279 WB: 5 Fatalities and 3 Incapacitating Injuries. All crashes occurred in dry conditions.	Hot Spot from MP 284 to 286 (EB): 3 Fatalities and 4 Incapacitating Injuries. All but one crash involved a single vehicle.	Hot Spot from MP 295-297 EB: 1 Fatality and 3 Incapacitating Injuries. 75% of crashes involved a single vehicle running off the road to a left.
Previously Completed Safety-Related Projects						Superelevation Improvements (MP 281 - 288)	Superelevation Improvements (MP 292 -298)
District Interviews/Discussions							
Contributing Factors		- Excessive speed - Poor visibility - Inadequate shoulders - Poor deliniation - Obstruction in or near roadway - Driver distraction/inattention - Peak hour congestion	- Excessive speed - Poor visibility - Inadequate shoulders - Poor deliniation - Driver distraction/inattention - Peak hour congestion	- Excessive speed - Poor nighttime visibility or lighting - Poor sign visibility - Obstruction in or near roadway - Driver distraction/inattention - Peak hour congestion - Ice and frost pavement condition	- Excessive speed - Poor nighttime visibility or lighting - Poor sign visibility - Inadequate shoulders - Driver distraction/inattention - Peak hour congestion	- Excessive speed - Poor nighttime visibility or lighting - Poor sign visibility - Inadequate shoulders - Pavement design - Obstruction in or near roadway - Driver distraction/inattention - Peak hour congestion - Wet pavement and standing water	- Excessive speed - Poor visibility - Inadequate shoulders - Poor deliniation - Driver distraction/inattention - Peak hour congestion - Wet pavement condition

Table 13: Safety Needs Contributing Factors (Step 3) (continued)

Segment Number		10E-13	10E-14	10E-15	10E-16	Corridor-Wide Crash Characteristics
Segment Length (miles)		17	22	18	20	
Segment Milepost (MP)		315 - 332	332 - 354	354 - 372	372 - 392	
Final Need		Low	Low	High	Low	
Segment Crash Overview		3 Crashes were fatal 15 Crashes had incapacitating injuries 0 Crashes involve trucks 0 Crashes involve Motorcycles	4 Crashes were fatal 14 Crashes had incapacitating injuries 5 Crashes involve trucks 0 Crashes involve Motorcycles	6 Crashes were fatal 5 Crashes had incapacitating injuries 3 Crashes involve trucks 0 Crashes involve Motorcycles	3 Crashes were fatal 9 Crashes had incapacitating injuries 2 Crashes involve trucks 1 Crashes involve Motorcycles	140 Crashes were fatal 270 Crashes had incapacitating injuries 52 Crashes involve trucks 28 Crashes involve Motorcycles
Segment Crash Summaries (Fatal and Serious Injury Crashes)	First Harmful Event Type	39% Involve Overturning 28% Involve Collision with Fixed Object 22% Involve Collision with Motor Vehicle	56% Involve Overturning 22% Involve Collision with Motor Vehicle 11% Involve Collision with Fixed Object	45% Involve Overturning 27% Involve Collision with Motor Vehicle 18% Involve Collision with Fixed Object	67% Involve Overturning 17% Involve Collision with Fixed Object 8% Involve Collision with Non-Fixed Object	39% Involve Overturning 36% Involve Collision with Motor Vehicle 15% Involve Collision with Fixed Object
	Collision Type	78% Involve Single Vehicle 17% Involve Rear End 6% Involve Other	67% Involve Single Vehicle 11% Involve Rear End 11% Involve Sideswipe (opposite)	45% Involve Single Vehicle 27% Involve Other 9% Involve Rear End	100% Involve Single Vehicle	54% Involve Single Vehicle 20% Involve Rear End 10% Involve Other
	Violation or Behavior	33% Involve Speed too Fast for Conditions 17% Involve Inattention/Distracted 11% Involve No Improper Action	39% Involve Speed too Fast for Conditions 33% Involve No Improper Action 11% Involve Inattention/Distracted	36% Involve No Improper Action 18% Involve Speed too Fast for Conditions 9% Involve Drove in Opposing Lane	42% Involve No Improper Action 42% Involve Speed too Fast for Conditions 8% Involve Inattention/Distracted	35% Involve Speed too Fast for Conditions 19% Involve No Improper Action 9% Involve Unknown
	Lighting Conditions	56% Occur in Daylight Conditions 33% Occur in Dark-Unlighted Conditions 6% Occur in Dusk Conditions	61% Occur in Daylight Conditions 39% Occur in Dark-Unlighted Conditions	55% Occur in Daylight Conditions 45% Occur in Dark-Unlighted Conditions	67% Occur in Daylight Conditions 33% Occur in Dark-Unlighted Conditions	56% Occur in Daylight Conditions 32% Occur in Dark-Unlighted Conditions 9% Occur in Dark-Lighted Conditions
	Surface Conditions	89% Involve Dry Conditions 11% Involve Wet Conditions	100% Involve Dry Conditions	100% Involve Dry Conditions	83% Involve Dry Conditions 17% Involve Wet Conditions	92% Involve Dry Conditions 6% Involve Wet Conditions
	First Unit Event	33% Involve a first unit event of Ran Off the Road (Right) 28% Involve a first unit event of Ran Off the Road (Left) 22% Involve a first unit event of Motor Vehicle in Transport	28% Involve a first unit event of Ran Off the Road (Left) 22% Involve a first unit event of Ran Off the Road (Right) 17% Involve a first unit event of Motor Vehicle in Transport	36% Involve a first unit event of Equipment Failure 18% Involve a first unit event of Ran Off the Road (Right) 9% Involve a first unit event of Ran Off the Road (Left)	42% Involve a first unit event of Ran Off the Road (Left) 33% Involve a first unit event of Equipment Failure 8% Involve a first unit event of Ran Off the Road (Right)	34% Involve a first unit event of Motor Vehicle in Transport 25% Involve a first unit event of Ran Off the Road (Left) 15% Involve a first unit event of Ran Off the Road (Right)
	Driver Physical Condition	44% No Apparent Influence 22% Unknown 17% Under the Influence of Drugs or Alcohol	44% No Apparent Influence 33% Unknown 17% Fatigued/Fell Asleep	64% No Apparent Influence 27% Unknown 9% Under the Influence of Drugs or Alcohol	67% No Apparent Influence 17% Fatigued/Fell Asleep 17% Unknown	52% No Apparent Influence 24% Unknown 15% Under the Influence of Drugs or Alcohol
	Safety Device Usage	50% Shoulder And Lap Belt Used 22% None Used 17% Air Bag Deployed/Shoulder-Lap Belt	72% Shoulder And Lap Belt Used 22% None Used 6% Unknown	64% Shoulder And Lap Belt Used 18% None Used 9% Other	75% Shoulder And Lap Belt Used 8% None Used 8% Helmet Used	58% Shoulder And Lap Belt Used 21% None Used 6% Unknown
Hot Spot Crash Summaries		Hot Spot from MP 317-318 EB: 1 Fatality and 3 Incapacitating Injuries. All crashes involved a single vehicle and dry conditions.	None	None	None	
Previously Completed Safety-Related Projects						
District Interviews/Discussions				- Effort to clear vegetation by district because it is obstructing sight lines	- Effort to clear vegetation by district because it is obstructing sight lines	
Contributing Factors		- Excessive speed - Poor nighttime visibility or lighting - Poor sign visibility - Inadequate shoulders - Pavement design - Obstruction in or near roadway - Driver distraction/inattention - Peak hour congestion - Wet pavement condition	- Excessive speed - Poor visibility - Inadequate shoulders - Poor delineation - Driver distraction/inattention - Peak hour congestion	- Excessive speed - Poor nighttime visibility or lighting - Poor sign visibility - Inadequate shoulders - Pavement design - Obstruction in or near roadway - Driver distraction/inattention - Peak hour congestion	- Excessive speed - Poor nighttime visibility or lighting - Poor sign visibility - Inadequate shoulders - Pavement design - Obstruction in or near roadway - Driver distraction/inattention - Wet pavement condition	

7.0 FREIGHT PERFORMANCE NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the I-10 East corridor for the Freight Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

7.1 Step 1: Initial Freight Needs

The baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the I-10 East corridor were used to determine the initial freight needs, as described in Section 2.1. The freight data used to calculate baseline performance was provided by ADOT for 2014 for the existing travel time data, 2010-2014 for the closure data, and 2015 for bridge clearance data.

Step 1 uses the scores for the Freight Index primary performance measure and four secondary performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The four secondary performance measures are Directional Truck Travel Time Index (TTTI), Directional Truck Planning Time Index (TPTI), Directional Closure Duration, and Bridge Vertical Clearance.

The performance scores, performance objectives, and initial levels of need for each freight performance measure and for all freight performance measures combined are shown in **Table 14**.

For the Freight Index, three segments report a “High” level of need and one segment reports a “Medium” level of need. For Directional TTTI, no segments have a “High” or “Medium” level of need in either direction. For Directional TPTI, two segments report a “High” level of need eastbound and three segments report a “High” level of need westbound. One eastbound segment reports a “Medium” level of need and zero westbound segments report “Medium” levels of need for Directional TPTI. For Directional Closure Duration, four segments have a “High” level of need in the eastbound direction and one segment has a “Medium” level of need in the eastbound and westbound directions. For Bridge Vertical Clearance, zero segments report a “High” level of need and eight segments report a “Medium” level of need. For all freight performance measures combined, three segments report a “High” level of initial need and one segment reports a “Medium” level of initial need.

7.2 Step 2: Final Freight Needs

Once the initial freight needs by segment for the I-10 East corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of vertical clearance hot spots as well as relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 15**.

Vertical Clearance Hot Spots

There are six segments containing one or more vertical clearance hot spots, which are bridges that provide less than 16.25 feet of vertical clearance above the corridor mainline through lanes and that cannot be ramped around. The locations of vertical clearance hot spots are listed in **Table 15**. As all of the segments with vertical clearance hot spots report an initial need, no adjustments were made to the need level of any segments to account for hot spots.

Recently Completed and Under-Construction Freight Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a freight need on a corridor segment.

There are segments containing recently completed projects which would supersede the freight condition data, as shown in **Table 15**. None of the recently completed projects alleviate the needs in the segments so no adjustments were made to the final level of need.

Planned or Programmed Projects

Information was noted in **Table 15** on freight-related planned and programmed projects and other issues identified in previous reports in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

Table 14: Initial Freight Needs (Step 1)

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Freight Index			Directional TTI (trucks only)					Directional PTI (trucks only)				
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
							EB	WB		EB	WB	EB	WB		EB	WB
10E-1	Uninterrupted	160-164	4	0.24	Fair or Better	High	1.18	1.27	Fair or Better	None	Low	3.45	4.84	Fair or Better	High	High
10E-2	Uninterrupted	164-184	20	0.88	Fair or Better	None	1.05	1.06	Fair or Better	None	None	1.13	1.13	Fair or Better	None	None
10E-3	Uninterrupted	184-198	14	0.87	Fair or Better	None	1.05	1.05	Fair or Better	None	None	1.15	1.14	Fair or Better	None	None
10E-4	Uninterrupted	198-218	20	0.87	Fair or Better	None	1.05	1.04	Fair or Better	None	None	1.15	1.15	Fair or Better	None	None
10E-5	Uninterrupted	218-236	18	0.88	Fair or Better	None	1.04	1.04	Fair or Better	None	None	1.16	1.11	Fair or Better	None	None
10E-6	Uninterrupted	236-246	10	0.90	Fair or Better	None	1.04	1.04	Fair or Better	None	None	1.11	1.11	Fair or Better	None	None
10E-7	Uninterrupted	246-255	9	0.68	Fair or Better	Medium	1.11	1.08	Fair or Better	None	None	1.66	1.28	Fair or Better	High	None
10E-8	Uninterrupted	255-262	7	0.62	Fair or Better	High	1.11	1.12	Fair or Better	None	None	1.32	1.89	Fair or Better	None	High
10E-9	Uninterrupted	262-274	12	0.63	Fair or Better	High	1.12	1.10	Fair or Better	None	None	1.50	1.65	Fair or Better	Medium	High
10E-10	Uninterrupted	274-280	6	0.88	Fair or Better	None	1.04	1.03	Fair or Better	None	None	1.12	1.14	Fair or Better	None	None
10E-11	Uninterrupted	280-292	12	0.81	Fair or Better	None	1.09	1.04	Fair or Better	None	None	1.28	1.17	Fair or Better	None	None
10E-12	Uninterrupted	292-315	23	0.83	Fair or Better	None	1.04	1.08	Fair or Better	None	None	1.16	1.24	Fair or Better	None	None
10E-13	Uninterrupted	315-332	17	0.80	Fair or Better	None	1.08	1.05	Fair or Better	None	None	1.27	1.22	Fair or Better	None	None
10E-14	Uninterrupted	332-354	22	0.78	Fair or Better	None	1.05	1.07	Fair or Better	None	None	1.27	1.30	Fair or Better	None	None
10E-15	Uninterrupted	354-372	18	0.91	Fair or Better	None	1.02	1.03	Fair or Better	None	None	1.09	1.12	Fair or Better	None	None
10E-16	Uninterrupted	372-392	20	0.86	Fair or Better	None	1.04	1.04	Fair or Better	None	None	1.18	1.14	Fair or Better	None	None
Freight Emphasis Area?	Yes	Corridor Weighted Average		0.82	Good	None										

Table 14: Initial Freight Needs (Step 1) (continued)

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Closure Duration (minutes/mile/year)					Bridge Clearance (feet)			Initial Need
				Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
				EB	WB		EB	WB				
10E-1	Uninterrupted	160-164	4	186.82	10.65	Fair or Better	High	None	16.84	Fair or Better	None	High
10E-2	Uninterrupted	164-184	20	69.81	31.56	Fair or Better	None	None	15.92	Fair or Better	Medium	Low
10E-3	Uninterrupted	184-198	14	37.09	59.32	Fair or Better	None	None	15.86	Fair or Better	Medium	Low
10E-4	Uninterrupted	198-218	20	156.81	25.30	Fair or Better	High	None	15.92	Fair or Better	Medium	Low
10E-5	Uninterrupted	218-236	18	69.10	48.87	Fair or Better	None	None	16.13	Fair or Better	Medium	Low
10E-6	Uninterrupted	236-246	10	91.93	91.18	Fair or Better	Low	Low	17.41	Fair or Better	None	Low
10E-7	Uninterrupted	246-255	9	54.75	16.82	Fair or Better	None	None	16.97	Fair or Better	None	Medium
10E-8	Uninterrupted	255-262	7	46.74	37.29	Fair or Better	None	None	16.32	Fair or Better	Low	High
10E-9	Uninterrupted	262-274	12	115.35	5.12	Fair or Better	Medium	None	16.13	Fair or Better	Medium	High
10E-10	Uninterrupted	274-280	6	90.33	57.23	Fair or Better	Low	None	16.15	Fair or Better	Medium	Low
10E-11	Uninterrupted	280-292	12	36.15	97.41	Fair or Better	None	Low	16.26	Fair or Better	Low	Low
10E-12	Uninterrupted	292-315	23	50.43	29.52	Fair or Better	None	None	16.20	Fair or Better	Low	Low
10E-13	Uninterrupted	315-332	17	13.44	30.32	Fair or Better	None	None	16.42	Fair or Better	None	None
10E-14	Uninterrupted	332-354	22	25.81	104.97	Fair or Better	None	Medium	15.94	Fair or Better	Medium	Low
10E-15	Uninterrupted	354-372	18	200.27	8.54	Fair or Better	High	None	16.31	Fair or Better	Low	Low
10E-16	Uninterrupted	372-392	20	186.17	13.34	Fair or Better	High	None	16.04	Fair or Better	Medium	Low

Table 15: Final Freight Needs (Step 2)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Vertical Clearance Hot Spots (Vertical Clearance < 16.25' and No Ramps)	Relevant Recently Completed or Under Construction Projects (which supersede performance data)*	Final Need	Comments (may include tentatively programmed projects with potential to address needs or other relevant issues identified in previous reports)
10E-1	4	160-164	High	None	Roadway widening at MP 162-164 New DMS at MP 163.5 (EB/WB)	High	Roadway widening and DMS did not alleviate the freight need
10E-2	20	164-184	Low	5 Bridges (Goodyear Rd UP – MP 169.85, #1149; Nelson Rd UP – MP 174.3, #1213; Casa Blanca TI UP – MP 175.81, # 1214; Gas Line Rd – MP 177.76, #1215; Seed Farm Rd – MP 179.39, #1216)	Paving project at MP 173-175	Low	Repaving did not alleviate the freight need
10E-3	14	184-198	Low	3 Bridges (Val Vista Blvd UP – MP 188.20, #1152; Cottonwood Ln UP – MP 193.88, #1154; Earley Rd UP – MP 195.89, #1158)	None	Low	
10E-4	20	198-218	Low	2 Bridges (Battaglia Rd UP – MP 205.45, #943; Alsdorf Rd UP - MP 207.17, #944)	None	Low	
10E-5	18	218-236	Low	1 Bridge (Pinal Air Park TI UP – MP 232.02, #771)	None	Low	Bridge can be ramped around in the EB direction
10E-6	10	236-246	Low	None	None	Low	
10E-7	9	246-255	Medium	None	New DMS at MP 254 (EB/WB)	Medium	New DMS did not alleviate the freight need
10E-8	7	255-262	High	None	None	High	
10E-9	12	262-274	High	None	None	High	
10E-10	6	274-280	Low	None	None	Low	
10E-11	12	280-292	Low	None	Paving project at MP 281-288	Low	Repaving did not alleviate the freight need
10E-12	23	292-315	Low	None	Paving project at MP 292-301	Low	Repaving did not alleviate the freight need
10E-13	17	315-332	None	None	Texas Canyon Rest Area Rehabilitation at MP 320	None	Rest area rehabilitation did not alleviate freight need
10E-14	22	332-354	Low	1 Bridge (Airport Rd UP – MP 339.46, #1114)	None	Low	
10E-15	18	354-372	Low	None	None	Low	
10E-16	20	372-392	Low	2 Bridges (W San Simon TI UP – MP 378.93, #1164; E San Simon TI UP – MP 382.35, #1169)	San Simon Rest Area Rehabilitation at MP 388	Low	Bridges can be ramped around in the WB direction; Rest area rehabilitation did not alleviate freight need

7.3 Step 3: Freight Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors include:

- Roadway variables
- Traffic variables
- Relevant freight-related existing infrastructure
- Closure type
- Non-actionable conditions

Roadway Variables

Roadway variables include functional classification, environmental type (e.g., urban, rural), terrain, number of lanes, speed limit, presence of auxiliary lanes, if a roadway is divided or non-divided, and how often passing is not allowed. These variables are described in more detail below:

- Functional classification indicates if a roadway is an interstate, state highway, or arterial. Capacity equations and parameters differ depending on a roadway's functional classification.
- Environmental type refers to how developed the land is adjacent to the roadway. Environmental types include urban, fringe urban, and rural. Capacity thresholds differ depending on the environmental type as higher congestion levels are more acceptable in urbanized areas than in rural areas.
- Terrain (described as level, rolling, or mountainous) indicates the general roadway grade, which influences how quickly vehicles can accelerate or decelerate or maintain a constant speed.
- The number of lanes in each direction indicates how many general purpose through lanes exist.
- The speed limit indicates the posted speed limit.
- The presence of auxiliary lanes for turning, weaving, or passing can improve mobility performance by maintaining more consistent speeds in mainline through lanes.
- A roadway is considered divided if it has a raised or depressed median separating the directions of traffic that cannot easily be traversed. A roadway with a painted paved median is considered a non-divided roadway. Dividing a roadway generally increases the roadway capacity.
- The presence of no-passing zones restricts the movement of vehicles around slower-moving vehicles.

Traffic Variables

Traffic variables include existing and future LOS, percent (%) trucks, and the buffer index (difference between PTI and TTI). The existing and future LOS, percentage of trucks, and buffer index can indicate how well a corridor is performing in terms of overall mobility and why certain segments of a corridor may be performing worse than others.

Existing and Future LOS

The existing and future LOS provide a letter "grade" between "A" and "F" for mobility that is generally reflective of Existing and Future V/C calculations. LOS values of "A", "B", and "C" are generally considered highly acceptable. A LOS value of "D" is generally considered moderately acceptable. LOS values of "E" and "F" are generally considered unacceptable.

Truck Traffic

The amount of truck traffic in a given segment of the corridor can be represented as a percentage of the overall total traffic volume for that specific segment. The truck volume on a corridor can impact overall mobility based on truck travel speed, corridor grades, required inspection points and number of lanes.

Buffer Index

The Buffer Index is calculated by subtracting the segment level TTI value (ratio of peak hour speed to free flow speed) from the segment level PTI value (95th percentile speed). The TTI and PTI values were determined in Working Paper 2. The buffer index expresses the amount of extra time necessary to be on-time 95 percent of the time for any given trip. This calculation provides information on the reliability of a corridor.

Freight-Related Infrastructure

Freight related infrastructure refers to devices or features at specific locations that influence freight performance. Examples include DMS, passing lanes, climbing lanes, POE, weigh stations, rest areas, and parking areas.

Closure Type

The relative frequency of types of closures within each segment helps indicate potential causes of freight-related needs. Closure types consist of closures due to an incident/crash, obstruction/hazard, or weather condition. The number of each type of closure and the corresponding percentage of all closures that are of each type are noted.

Non-Actionable Conditions

Non-actionable conditions are features or characteristics that result in poor freight performance that cannot be addressed through an engineered solution. Examples include border patrol checkpoints that require all vehicles to slow down or stop for inspection.

Freight Needs Contributing Factors

Table 16 summarizes the potential contributing factors to freight needs on the I-10 East corridor.

Table 16: Freight Needs Contributing Factors (Step 3)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables							Traffic Variables						Relevant Freight Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Speed Limit	Aux Lanes	Divided/ Non-Divided	% No Passing	Existing LOS	Future 2035 LOS	% Trucks	NB Buffer Index (TPTI-TTI)	SB Buffer Index (TPTI-TTI)	
10E-1	160-164	4	High	Interstate	Urban	Level	2-3	65	Yes	Divided	0%	A-C	D	14%	2.27	3.57	DMS at MP 163.5
10E-2	164-184	20	Low	Interstate	Rural	Level	2	65-75	No	Divided	0%	A-C	E/F	14%	0.08	0.08	Rest Area at MP 183
10E-3	184-198	14	Low	Interstate	Fringe Urban	Level	2-3	75	Yes	Divided	0%	A-C	A-C	12%	0.10	0.10	DMS at MP 195.6
10E-4	198-218	20	Low	Interstate	Fringe Urban	Level	2-3	75	No	Divided	0%	A-C	A-C	21%	0.11	0.11	DMS at MP 205.2
10E-5	218-236	18	Low	Interstate	Rural	Level	3	75	No	Divided	0%	A-C	A-C	21%	0.12	0.07	None
10E-6	236-246	10	Low	Interstate	Fringe Urban	Level	3	75	Yes	Divided	0%	A-C	A-C	15%	0.07	0.08	DMS at MP 237.2 and MP 243.3
10E-7	246-255	9	Medium	Interstate	Urban	Level	3	65-75	Yes	Divided	0%	D	E/F	12%	0.55	0.20	DMS at MP 249.4 and MP 254
10E-8	255-262	7	High	Interstate	Urban	Level	3-4	65	No	Divided	0%	D	E/F	12%	0.21	0.77	DMS at MP 257.3, MP 257.6, and MP 261.8
10E-9	262-274	12	High	Interstate	Urban	Level	2-3	65-75	No	Divided	0%	A-C	E/F	15%	0.38	0.54	DMS at MP 263.2 and MP 270
10E-10	274-280	6	Low	Interstate	Urban	Level	2	75	No	Divided	0%	A-C	A-C	19%	0.08	0.11	None
10E-11	280-292	12	Low	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A-C	A-C	21%	0.20	0.13	DMS at MP 280.8 and MP 282.5
10E-12	292-315	23	Low	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A-C	D	30%	0.11	0.17	DMS at 300.6 and MP 308.8
10E-13	315-332	17	None	Interstate	Rural	Rolling	2	75	No	Divided	0%	A-C	D	39%	0.19	0.17	Rest Area at MP 320
10E-14	332-354	22	Low	Interstate	Rural	Rolling	2	75	No	Divided	0%	A-C	A-C	37%	0.22	0.23	DMS at MP 347.9
10E-15	354-372	18	Low	Interstate	Rural	Rolling	2	75	No	Divided	0%	A-C	A-C	38%	0.07	0.08	DMS at MP 362.2
10E-16	372-392	20	Low	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A-C	A-C	39%	0.13	0.10	DMS at MP 385.2, POE/Weigh Station at MP 383, and Rest Area at MP 388

Table 16: Freight Needs Contributing Factors (Step 3) (continued)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total Number of Closures	# Incidents/Accidents	% Incidents/Accidents	# Obstructions/Hazards	% Obstructions/Hazards	# Weather Related	% Weather Related			
10E-1	160-164	4	High	12	12	100%	0	0%	0	0%	None	Programmed: New general purpose and HOV lane at MP 161-164	- Percent of closures due to Incidents/Accidents above statewide average
10E-2	164-184	20	Low	35	35	100%	0	0%	0	0%	None	Programmed: New general purpose and HOV lane at MP 161-164	- Percent of closures due to Incidents/Accidents above statewide average
10E-3	184-198	14	Low	33	33	100%	0	0%	0	0%	None		- Percent of closures due to Incidents/Accidents above statewide average
10E-4	198-218	20	Low	28	27	96%	0	0%	1	4%	None	Programmed: I-8 System TI Reconstruction at MP 199	- Percent of closures due to Incidents/Accidents above statewide average - One closure due to severe weather warning
10E-5	218-236	18	Low	21	21	100%	0	0%	0	0%	None		- Percent of closures due to Incidents/Accidents above statewide average
10E-6	236-246	10	Low	24	24	100%	0	0%	0	0%	None	Final DCR for I-10 (MP 240.0-247.5), Tangerine Rd to Cortaro Rd; Widen from a 6-lane to a 8-lane freeway; Reconstruct Tangerine, Avra Valley Rd, and Twin Peaks Rd TIs	- Percent of closures due to Incidents/Accidents above statewide average
10E-7	246-255	9	Medium	19	18	95%	1	5%	0	0%	None	Final DCR for I-10 (MP 247.5-253.4), Ina Rd to Ruthrauff Rd; Widen from a 6-lane to a 8-lane freeway; Reconstruct Ina Rd, Orange Grove Rd, Sunset Rd and Ruthrauff Rd TIs	- Percent of closures due to Incidents/Accidents and Obstructions/Hazards above statewide average - One closure due to flooding
10E-8	255-262	7	High	18	18	100%	0	0%	0	0%	None		- Percent of closures due to Incidents/Accidents above statewide average
10E-9	262-274	12	High	29	29	100%	0	0%	0	0%	None	Programmed: Kino Pkwy Bridge at MP 262; Craycroft Bridge at MP 268; Wilmot Bridge at MP 269; Park Ave TI Reconstruction at MP 262; Kino Pkwy TI Reconstruction at MP 263; Construct Country Club Rd TI at MP 264	- Percent of closures due to Incidents/Accidents above statewide average
10E-10	274-280	6	Low	21	21	100%	0	0%	0	0%	None	Programmed: Houghton Rd TI Reconstruction at MP 275	- Percent of closures due to Incidents/Accidents above statewide average
10E-11	280-292	12	Low	27	27	100%	0	0%	0	0%	None	Climbing and Passing Lane Prioritization Study; Proposed Climbing Lane at MP 286-291 (EB) – Tier 2 Moderate Priority	- Percent of closures due to Incidents/Accidents above statewide average
10E-12	292-315	23	Low	31	30	97%	1	3%	0	0%	None	Climbing and Passing Lane Prioritization Study; Proposed Climbing Lane MP 309-311 (EB) – Tier 1 High Priority; Proposed Climbing Lane at MP 302-306 (WB) – Tier 3 Low Priority	- Percent of closures due to Incidents/Accidents above statewide average - One closure due to brush fire
10E-13	315-332	17	None	18	18	100%	0	0%	0	0%	None	Climbing and Passing Lane Prioritization Study; Proposed Climbing Lane at MP 315-317 (EB) – Tier 3 Low Priority	- Percent of closures due to Incidents/Accidents above statewide average

Table 16: Freight Needs Contributing Factors (Step 3) (continued)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related			
10E-14	332-354	22	Low	14	14	100%	0	0%	0	0%	None		- Percent of closures due to Incidents/Accidents above statewide average
10E-15	354-372	18	Low	15	14	93%	1	7%	0	0%	None		- Percent of closures due to Incidents/Accidents and Obstructions/Hazards about statewide average - One closure due to unknown obstruction or hazard
10E-16	372-392	20	Low	10	10	100%	0	0%	0	0%	None		- Percent of closures due to Incidents/Accidents above statewide average

8.0 SEGMENT REVIEW (STEP 4)

As part of Step 4, the final needs results for each segment were combined to estimate the average level of need for each segment of I-10 East corridor, as described in Section 2.4. During the Corridor Goals and Objectives development process for the I-10 East corridor, the Mobility, Safety, and Freight Performance Areas were identified as Emphasis Areas. Therefore, a weighting

factor of 1.50 was applied to those performance area needs as discussed in Section 2.4. A summary of the segment needs is shown in **Table 17** along with the resulting average need. These results are intended for use to compare the level of need across corridors. The average level of need by segment is shown for the I-10 East corridor in **Figure 7**.

Table 17: Segment Needs Summary

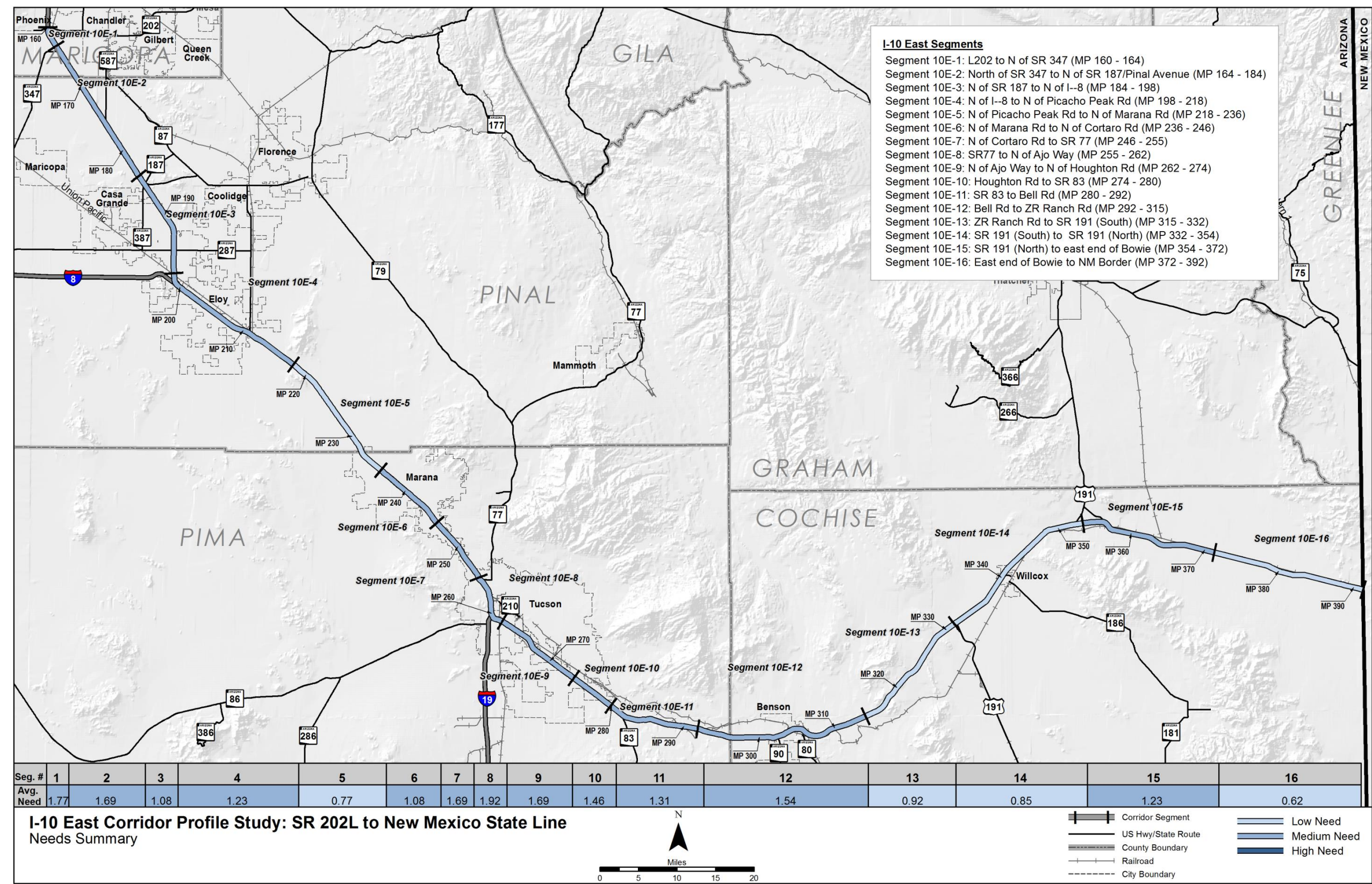
Performance Area	10E-1	10E-2	10E-3	10E-4	10E-5	10E-6	10E-7	10E-8	10E-9	10E-10	10E-11	10E-12	10E-13	10E-14	10E-15	10E-16
	MP 160-164	MP 164-184	MP 184-198	MP 198-218	MP 219-236	MP 236-246	MP 246-255	MP 255-262	MP 262-274	MP 274-280	MP 280-292	MP 292-315	MP 315-332	MP 332-354	MP 354-372	MP 372-392
Pavement	None	Low	Low	Low	None	None	None	Low	None	None	None	None	None	None	Low	None
Bridge	Low	Low	None	Low	Medium	Low	Medium	Low	Medium	Medium	Low	Low	High	Low	Low	Low
Mobility*	Low	High	None	None	None	None	High	High	Medium	Low	Medium	Medium	Low	Low	None	None
Safety*	High	Medium	High	High	Low	High	Low	Low	Low	High	Medium	High	Low	Low	High	Low
Freight*	High	Low	Low	Low	Low	Low	Medium	High	High	Low	Low	Low	None	Low	Low	Low
Average Need (0-3)	1.77	1.69	1.08	1.23	0.77	1.08	1.69	1.92	1.69	1.46	1.31	1.54	0.92	0.85	1.23	0.62

*Identified as Emphasis Area

+A segment need rating of ‘None’ does not indicate a lack of needed improvements; rather, it indicated that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.

Need Category	Average Need Range
None+	< 0.1
Low	0.10 – 1.00
Medium	1.00 – 2.00
High	2.00 – 3.00

Figure 7: Needs Summary



9.0 CORRIDOR NEEDS (STEP 5)

Step 5 translates the performance-based needs into corridor needs that are “actionable”. These needs can facilitate development of solutions (projects, initiatives, countermeasures, and programs) to improve corridor performance through strategic investments in preserving, modernizing, and/or expanding the corridor. Corridor needs were developed through a segment-by-segment review of needs and contributing factors. This review also identified overlapping, common, and contrasting needs across performance areas.

Figure 8 shows the corridor need locations for each performance area and programmed projects for fiscal year (FY) 2016-2020. Programmed projects have not yet been constructed and may address identified needs or be modified as part of the development of strategic investments.

For additional detail on specific needs by location, refer to the information in Step 3.

9.1 Description of Needs by Performance Area

Pavement Needs

The Pavement Performance Area is not an emphasis area for the I-10 East corridor. Five of 16 segments, 79 miles (34 percent), of the I-10 East corridor exhibit “Low” level of needs in Pavement Performance. These segments include:

- Segment 10E-2 MP 164 - 184
- Segment 10E-3 MP 184 - 198
- Segment 10E-4 MP 198 - 218
- Segment 10E-8 MP 255 - 262
- Segment 10E-15 MP 354 - 372

Pavement hot spot failure needs were identified along the corridor, including areas that have levels of historical investment. Hot spots that will be addressed by a programmed project are not included.

- Hot Spots Failures
 - MP 197 - 198
 - MP 210 - 211
 - MP 260 - 262
 - MP 366 - 367
- Both Low PSR, and Composite scores
 - MP 185 - 186
 - MP 210 - 211
 - MP 260 - 262
 - MP 366 - 367
- Low Pavement Distress Index (PDI), and Composite scores
 - MP 172 - 173
 - MP 175 - 176
 - MP 292 - 294
 - MP 296 - 297

- MP 341 - 342
- Four segments were observed to have “Low” historical investment with mill and replace projects or overlay treatment projects
- Ten segments were observed to have “Medium” historical investment with mill and overlay projects
- Two segments were observed to have “High” historical investment with reconstruction projects

Bridge Needs

The Bridge Performance Area is not an emphasis area for the I-10 East corridor. Ten of 16 segments of the I-10 East corridor exhibit “Low” level of need in Bridge Performance. The segments include:

- Segment 10E-1 MP 160 - 164
- Segment 10E-2 MP 164 - 184
- Segment 10E-4 MP 198 - 218
- Segment 10E-6 MP 236 - 246
- Segment 10E-8 MP 255 - 262
- Segment 10E-11 MP 280 - 292
- Segment 10E-12 MP 292 - 315
- Segment 10E-14 MP 332 - 354
- Segment 10E-15 MP 354 - 372
- Segment 10E-16 MP 372 - 392

Four of 16 segments of the I-10 East corridor exhibit “Medium” level of need in Bridge Performance. The segments include:

- Segment 10E-5 MP 218 - 236
- Segment 10E-7 MP 246 - 255
- Segment 10E-9 MP 262 - 274
- Segment 10E-10 MP 274 - 280

One of 16 segments of the I-10 East corridor exhibit “High” level of need in Bridge Performance. The segments include:

- Segment 10E-13 MP 315 - 332

Three of 33 bridges exhibit “High” levels of historical bridge maintenance investment.

- Chandler Blvd UP, MP 160.77
- Wild Horse Pass Blvd TI UP, MP 162.54
- Earley Rd UP, MP 195.89
- Battaglia Rd UP, MP 205.45
- Drain Channel Br WB OP, MP 209.85
- E Picacho TI OP EB, MP 212.21
- Red Rock RI UP, MP 226.45

- Pinal Air Park TI UP, MP 232.02
- Tangerine TI OP WB, MP 240.45
- Ina Rd TI OP EB & WB, MP 248.72
- Sunset Rd TI OP EB, MP 251.18
- Ruthrauff Rd TI OP EB, MP 252.43
- Park Ave TI OP EB, MP 261.72
- Ajo Way OP EB & WB, MP 262.44
- Kino Pkwy TI UP NB & SB, MP 262.53
- Diversion Chnl Br WB OP, MP 262.82
- Country Club OP EB, MP 263.82
- Palo Verde TI OP EB, MP 264.37
- Earp Wash Trib EB & WB OP, MP 267.65
- Wilmot Rd TI OP EB & WB, MP 269.36
- Kolb Rd TI UP, MP 270.58
- Rita Rd TI OP, MP 273.14
- Mountain View TI UP, MP 281.36
- Mescal Rd TI UP, MP 297.17
- San Pedro Riv Br EB OP, MP 306.75
- Johnson Rd TI UP, MP 322.60
- Stewart Rd UP, MP 344.30
- W San Simon TI UP, MP 378.93

Eight bridge rehabilitation projects are programmed in FY 2016 – 2020 (in Current Program) which could address deficiencies at the Kino Pkwy TI UP (NB & SB), Craycroft TI OP (EB & WB), Wilmot Rd TI OP (EB & WB), Adams Peak Wash Br OP (WB), and Island Wash Br OP (WB). Three bridge rehabilitation projects are programmed in FY 2017 – 2021 (in Tentative Program) which could address deficiencies at the Wash Bridge OP (EB), Vail Rd TI UP (EB), and Mountain View TI UP.

Key contributing factors/needs are summarized below

- 41 bridges have current ratings of one 5
- 16 bridges have current ratings of multiple 5s
- 16 bridges have currents ratings of one or more 4s
- 33 bridges have potential repetitive investment issues which may be candidates for life-cycle cost analysis to evaluate alternative solutions

Mobility Needs

The Mobility Performance Area is an emphasis area for the I-10 East corridor. Four of 16 segments of the I-10 East corridor exhibit “Low” need in Mobility Performance. Segments include:

- Segment 10E-1 MP 160 - 164
- Segment 10E-10 MP 274 - 280
- Segment 10E-13 MP 315 - 332
- Segment 10E-14 MP 332 – 354

Three of 16 segments of the I-10 East corridor exhibit “Medium” need in Mobility Performance. Segments include:

- Segment 10E-9 MP 262 - 274
- Segment 10E-11 MP 280 - 292
- Segment 10E-12 MP 292 - 315

Three of 16 segments of the I-10 East corridor exhibit “High” need in Mobility Performance. Segments include:

- Segment 10E-2 MP 164 - 184
- Segment 10E-7 MP 246 - 255
- Segment 10E-8 MP 255 - 262

Mobility needs are summarized below that specify focus areas for the I-10 East corridor.

- The number of closures on I-10 East due to incidents/accidents, obstructions/hazards, or weather are above statewide average for the entire corridor.
 - MP 160 - 164 (incidents/accidents)
 - MP 164 - 184 (incidents/accidents)
 - MP 184 - 198 (incidents/accidents)
 - MP 198 - 218 (incidents/accidents and weather)
 - MP 218 - 236 (incidents/accidents)
 - MP 236 - 246 (incidents/accidents)
 - MP 246 - 255 (obstructions/hazards)
 - MP 255 - 262 (incidents/accidents)
 - MP 262 - 274 (incidents/accidents)
 - MP 274 - 280 (incidents/accidents)
 - MP 280 - 292 (incidents/accidents)
 - MP 292 - 315 (incidents/accidents and obstructions/hazards)
 - MP 315 - 332 (incidents/accidents)
 - MP 332 - 354 (incidents/accidents)
 - MP 354 - 372 (obstructions/hazards)
 - MP 372 - 392 (incidents/accidents)

Safety Needs

The Safety Performance Area is an emphasis area for the I-10 East corridor. All 16 segments of the I-10 East corridor exhibit needs in Safety Performance. Seven of the 16 segments have “Low” or “High” level of need and two have a “Medium” level of need. Safety needs by segment and the milepost of crash location are summarized below with the key characteristics that exceed statewide average.

- Segment 10E-1 MP 160 - 164
 - Involve Collision with Pedestrian
 - Involve Failure to Keep Proper Lane
 - Involve Inattention/Distraction

- Involve Ran Off the Road (Left)
 - Involve Ran Off the Road (Right)
- Segment 10E-2 MP 164 - 184
 - Involve Rear End Collision
 - Involve Angle Crashes
 - Involve Speed too Fast for Conditions
 - Involve Dark-Unlighted Conditions
- Segment 10E-3 MP 184 - 198
 - Involve Overturning/Rollover
 - Involve Sideswipe (Same)
 - Involve Failure to Keep Proper Lane
 - Involve Dark-Unlighted Conditions
 - Involve Ran Off the Road (Left)
- Segment 10E-4 MP 198 - 218
 - Involve Overturning/Rollover
 - Involve Rear End Collision
 - Involve Unsafe Lane Change
 - Involve Dark-Unlighted Condition
- Segment 10E-5 MP 218 - 236
 - Involve Collision with Pedestrian
 - Involve Rear End Collision
 - Involve Sideswipe (Same)
 - Involve Speed too Fast for Conditions
 - Involve Dark-Unlighted Conditions
 - Involve Ran off the Road (Right)
- Segment 10E-6 MP 236 - 246
 - Involve Collision with Pedestrian
 - Involve Dark-Unlighted Conditions
 - Involve Ran off the Road (Left)
- Segment 10E-7 MP 246 - 255
 - Involve Overturning/Rollover
 - Involve Collision with Fixed Object
 - Involve Angle Crashes
 - Involve Speed too Fast for Conditions
 - Involve Ran off the Road (Right)
 - Involve Ran off the Road (Left)
- Segment 10E-8 MP 255 - 262
 - Involve Collision with Pedestrian
 - Involve Rear End Collision
 - Involve Sideswipe (Same)
- Involve Failure to Keep Proper Lane
 - Involve Ran off Road (Right)
- Segment 10E-9 MP 262 - 274
 - Involve Collision with Fixed Object
 - Involve Rear End Collision
 - Involve Failure to Keep Proper Lane
 - Involve Dark-Unlighted Conditions
 - Involve Ran off Road (Left)
- Segment 10E-10 MP 274 - 280
 - Involve Overturning/Rollover
 - Involve Rear End Collision
 - Involve Head On Collision
 - Involve Drove in Opposing Lane
 - Involve Dark-Unlighted Conditions
 - Involve Ran off Road (Right)
- Segment 10E-11 MP 280 - 292
 - Involve Collision with Fixed Object
 - Involve Sideswipe (Same)
 - Involve Speed too Fast for Conditions
 - Involve Dark-Unlighted Conditions
 - Involve Ran off Road (Right)
- Segment 10E-12 MP 292 - 315
 - Involve Overturning/Rollover
 - Involve Collision with Pedestrian
 - Involve Rear End Collision
- Segment 10E-13 MP 315 - 332
 - Involve Collision with Fixed Object
 - Involve Rear End Collision
 - Involve Inattention/Distracted
 - Involve Dark-Unlighted Conditions
 - Involve Ran off Road (Right)
- Segment 10E-14 MP 332 - 354
 - Involve Overturning/Rollover
 - Involve Sideswipe (Opposite)
 - Involve Speed too Fast for Conditions
 - Involve Dark-Unlighted Conditions
 - Involve Ran off Road (Right)

- Segment 10E-15 MP 354 - 372
 - Involve Collision with Fixed Object
 - Involve Drove in Opposing Lane
 - Involve Dark-Unlighted Conditions
 - Involve Ran off Road (Right)
- Segment 10E-16 MP 372 - 392
 - Involve Overturning/Rollover
 - Involve Collision with Fixed Object
 - Involve Collision with Non-Fixed Object
 - Involve Dark-Unlighted Conditions
 - Involve Ran off Road (Left)

Freight Needs

The Freight Performance Area is an emphasis area for the I-10 East corridor. Fifteen of 16 segments of the I-10 East corridor exhibit needs in Freight Performance. There are 11 segments with a “Low” level of need. There is one segment with a “Medium” level of need. There are three segments with a “High” level of need.

Similar to Mobility, road closures impact freight performance, these are summarized below that specify focus areas for the I-10 East corridor.

- The number of closures on the I-10 East corridor due to incidents/accidents or obstructions/hazards are above statewide average in the following areas:
 - MP 160 - 164 (incidents/accidents)
 - MP 164 - 184 (incidents/accidents)
 - MP 184 - 198 (incidents/accidents)
 - MP 198 - 218 (incidents/accidents)
 - MP 218 - 236 (incidents/accidents)
 - MP 236 - 246 (incidents/accidents)
 - MP 246 - 255 (incidents/accidents and obstructions/hazards)
 - MP 255 - 262 (incidents/accidents)
 - MP 262 - 274 (incidents/accidents)
 - MP 274 - 280 (incidents/accidents)
 - MP 280 - 292 (incidents/accidents)
 - MP 292 - 315 (incidents/accidents and obstructions/hazards)
 - MP 315 - 332 (incidents/accidents)
 - MP 332 - 354 (incidents/accidents)
 - MP 354 - 372 (incidents/accidents and obstructions/hazards)
 - MP 372 - 392 (incidents/accidents)
- Low trip reliability on the corridor occurs in the following areas:
 - MP 160 - 164
 - EB MP 246 - 255
 - WB MP 255 - 274
 - MP 262 - 274

9.2 Overlapping Needs

This section identifies overlapping performance needs on the I-10 East corridor, which provides guidance to develop strategic solutions that address more than one performance area. Completing projects that address multiple needs may present the opportunity for cost savings as well as more effectively improving overall performance. The map in **Figure 8** shows the extent of overlapping needs. Overlapping needs are summarized below.

- MP 173 – 174, MP 179 – 180, MP 261 – 262, and MP 297 – 298 have overlapping needs in all five performance areas.
- MP 168 – 173, MP 174 – 179, MP 180 – 184, MP 260 – 261, and MP 298 – 299 have overlapping needs in the Safety, Pavement, Freight, and Mobility areas.
- MP 160 – 161, MP 162 – 163, MP 167 – 168, MP 246 – 247, MP 248 – 249, MP 250 - 253, MP 262 – 265, MP 267 – 271, MP 273 – 274, MP 277 – 278, MP 279 – 280, MP 281 – 282, MP 284 – 285, MP 292 – 293, MP 299 – 300, MP 306 – 308, MP 309 – 310, MP 312 – 313, MP 336 – 337, MP 339 – 340, and MP 344 – 345 have overlapping needs in the Safety, Bridge, Freight, and Mobility areas.
- MP 198 – 199, MP 209 – 213, and MP 363 – 365 have overlapping needs in the Safety, Pavement, Bridge, and Freight areas.
- MP 161 – 162, MP 163 – 167, MP 247 – 248, MP 249 – 250, MP 253 – 260, MP 265 – 267, MP 271 – 273, MP 274 – 277, MP 278 – 279, MP 280 – 281, MP 282 – 284, MP 285 – 292, MP 293 – 297, MP 300 – 306, MP 308 – 309, MP 310 – 312, MP 313 – 315, MP 332 – 336, MP 337 – 339, MP 340 – 344, and MP 345 - 354 have overlapping needs in the Safety, Freight, and Mobility areas.
- MP 184 – 187, MP 196 – 198, MP 199 – 200, and MP 365 – 368 have overlapping needs in Safety, Pavement, and Freight areas.
- MP 195 – 196, MP 200 – 201, MP 205 – 206, MP 223 – 224, MP 232 – 233, MP 236 – 237, MP 240 – 241, MP 355 – 356, MP 378 – 379, MP 381 – 382, and MP 389 – 390 have overlapping needs in Safety, Bridge, and Freight areas.
- MP 322 – 323 and MP 331 – 332 have overlapping needs of Safety, Bridge, and Mobility areas.
- MP 187 – 195, MP 201 – 205, MP 206 – 209, MP 213 – 223, MP 224 – 232, MP 233 – 236, MP 237 – 240, MP 241 – 246, MP 354 – 355, MP 356 – 363, MP 368 – 378, MP 379 – 381, MP 382 – 389, and MP 390 – 392 have overlapping needs of Safety and Freight areas.
- MP 315 – 322 and MP 323 – 331 have overlapping needs of Safety and Mobility areas.

Figure 8: Summary of Needs and Programmed Projects

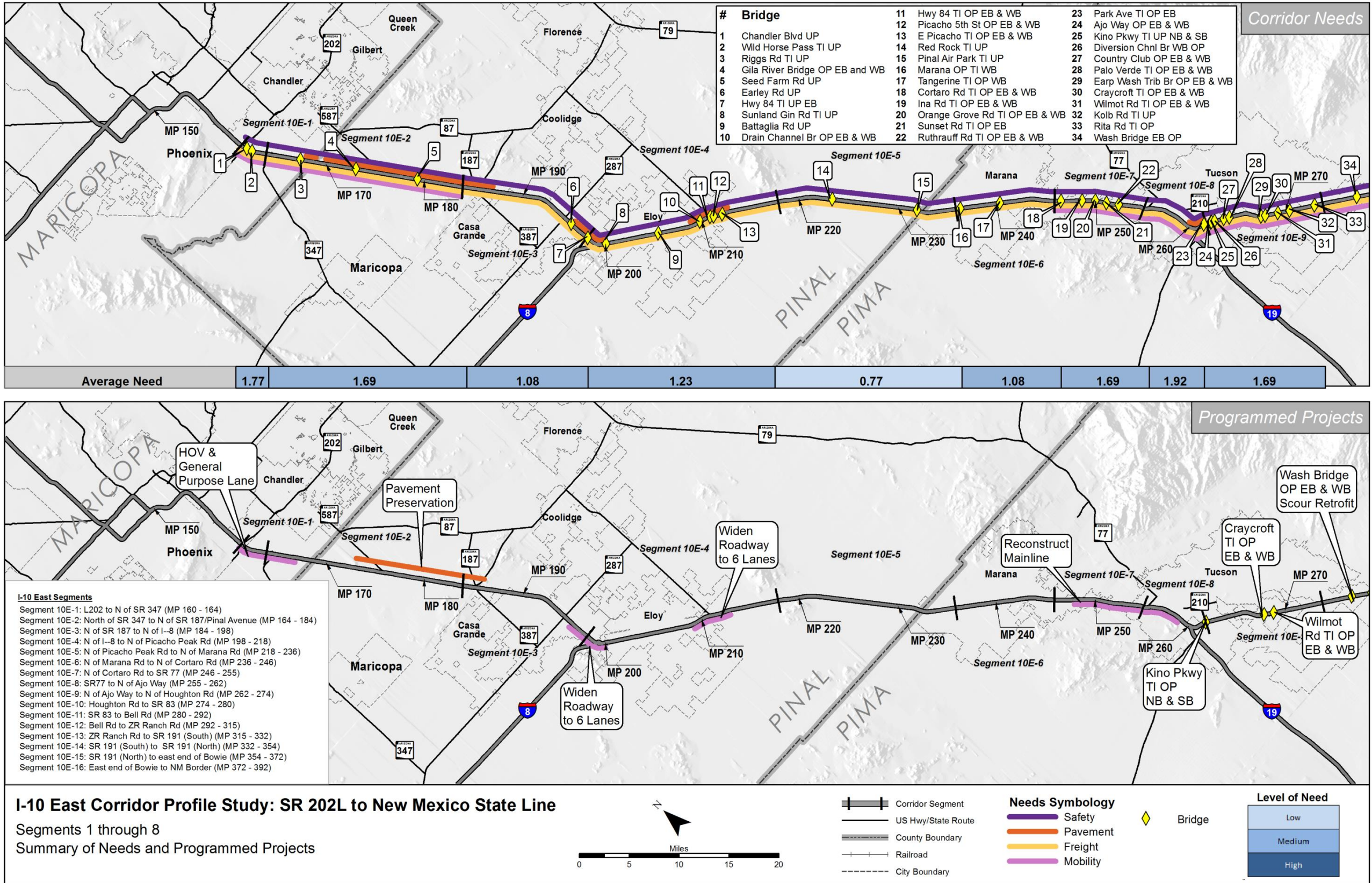
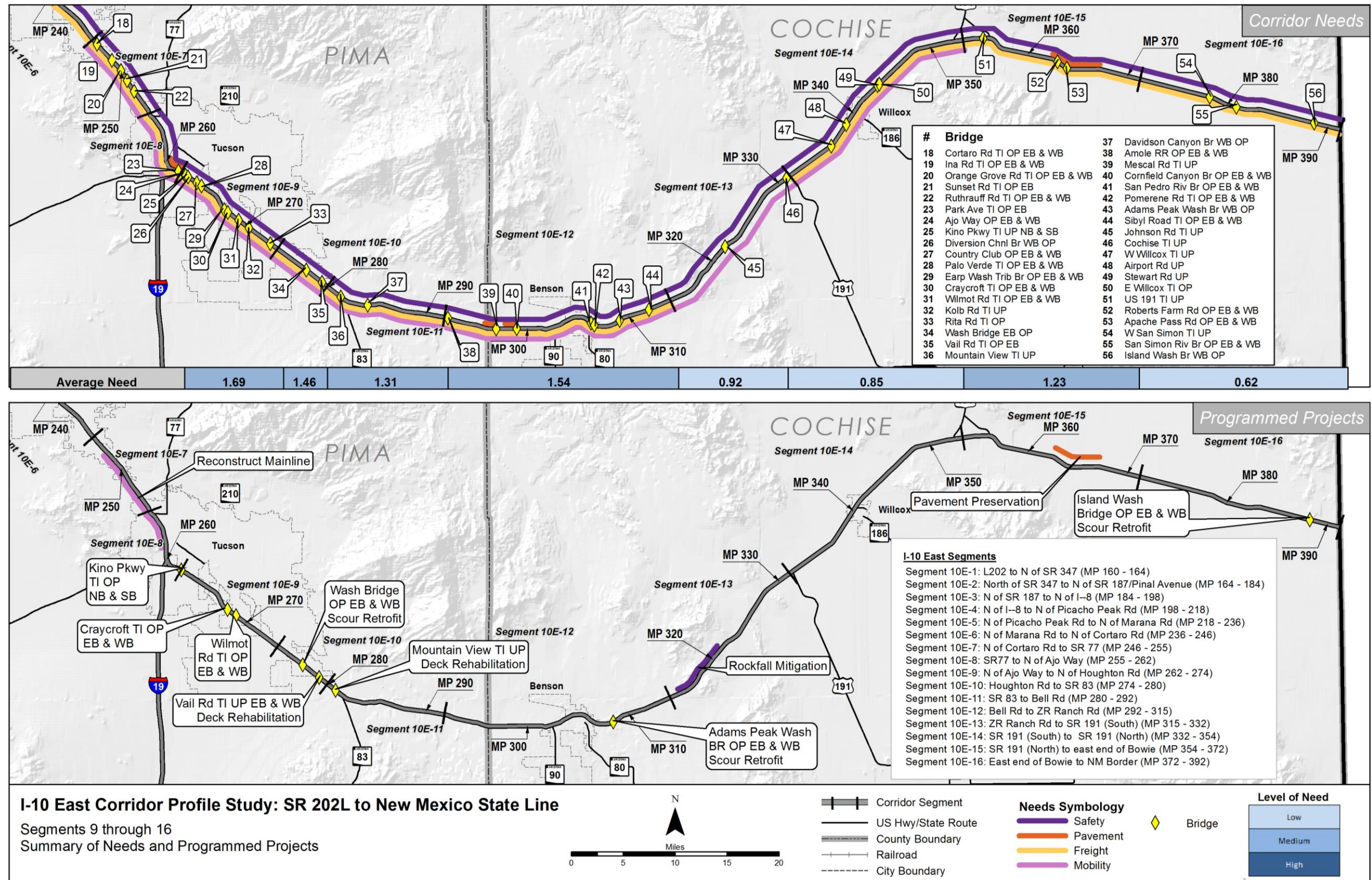


Figure 8: Summary of Needs and Programmed Projects (continued)



10.0 NEXT STEPS

The principal objective of the corridor profile study is to identify strategic solutions (investments) that are performance-based to ensure that available funds maximize the performance of the State's most strategic transportation corridors.

The actionable performance needs documented in Working Paper 4 will serve as a foundation for developing strategic investments for corridor preservation, modernization, and expansion. Strategic investments are not intended to be a substitute or replacement for traditional ADOT project development processes where various candidate projects are developed for consideration in programming in the P2P Link process. Rather, strategic investments are intended to complement ADOT's traditional project development processes with non-traditional projects to address performance needs in one or more of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Strategic investments will be considered along with other candidate projects in the ADOT programming process.

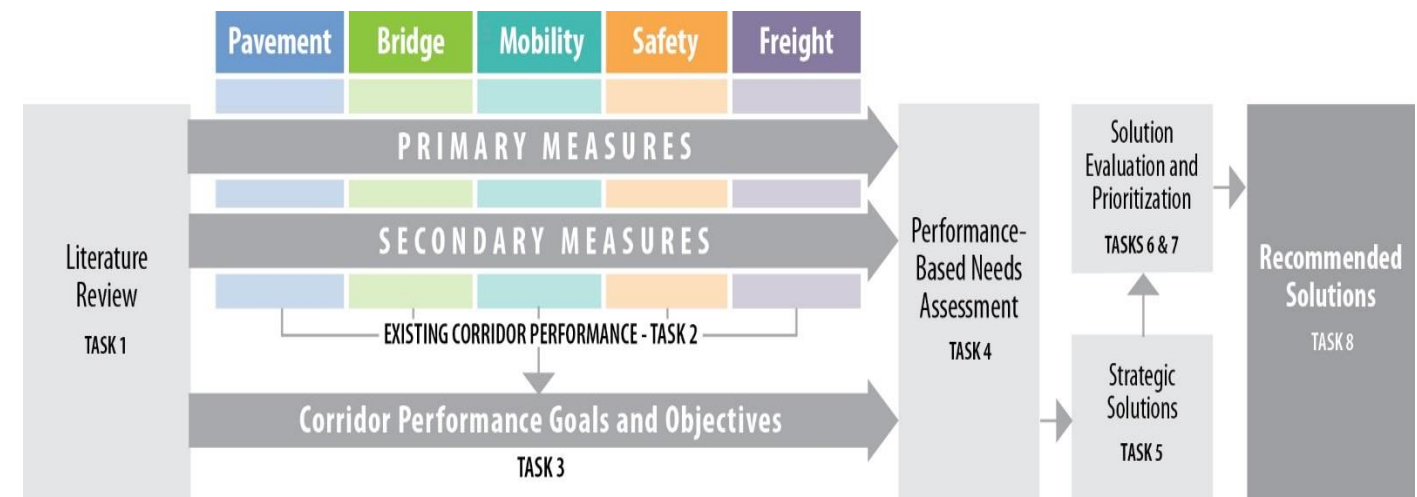
Illustrative examples of strategic investments are:

- *Projects that address significant performance needs.* Projects that address a "Medium" or "High" performance need identified in the corridor profile study that have a high probability to significantly improve corridor performance may be identified as strategic investments. These projects may include a project in the current program, a planned project not in the current program, or a new project recommended in the corridor profile study.
- *Projects that address needs in multiple performance areas.* For example, a single project to rehabilitate the roadway pavement surface and multiple bridge decks on a segment of roadway would address multiple performance areas (Pavement and Bridge) and could result in significant cost savings in traffic control (as compared to traffic control costs for separate projects to rehabilitate pavement surface and bridge decks). Another example would be that a travel lane pavement rehabilitation project could be expanded to include shoulder rehabilitation and rumble strip construction to reduce road departure safety needs.
- *Projects that address repetitive issues.* For example, if there is a history of high levels of maintenance activities at a particular bridge or segment of pavement, there may be an underlying need that, if addressed properly, will reduce the need for future maintenance. Higher-cost strategic capital investments to correct repetitive maintenance issues can result in life cycle cost savings by reducing maintenance costs over time.
- *Phased projects that achieve a long-term improvement objective.* For example, a life cycle cost analysis may recommend total pavement reconstruction to address a subgrade failure, however the cost of reconstruction may not be feasible from a funding perspective. A strategic investment may be recommended to extend the life of the current pavement infrastructure until funding availability allows for full pavement reconstruction.
- *Projects that utilize innovative solutions to extend the operational life of infrastructure or improve performance.* Innovative solutions that modernize a segment of roadway may be identified as strategic investments. Examples of modernization activities include widening of shoulders, access control, replacement/enhancement of infrastructure to address obsolescence, hazard elimination, and the application of various traffic control and

management technologies to improve traffic flow at a lower cost than traditional expansion solutions.

Strategic investments will be developed in Task 5 of the corridor profile study to address specific performance needs on the I-10 East corridor. In addition, meetings will be conducted with ADOT staff to discuss alternatives for addressing infrastructure performance needs that can be evaluated through a systematic analysis of life cycle costs and risks. **Figure 9** shows the tasks in the Corridor Profile Study process.

Figure 9: Corridor Profile Study Process



APPENDIX A: METHODOLOGIES FOR DETERMINING PERFORMANCE AREA NEEDS (STEPS 1-3)

Pavement Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Pavement Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate “Performance Score” columns. This includes the primary and secondary measures for Pavement. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of “None” (score = 0), “Low” (score = 1), “Medium” (score = 2), and “High” (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled “Needs Assessment Scales” within the Step 1 template.

To develop an aggregate Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of “None” (score < 0.01), “Low” (score \geq 0.01 and < 1.5), “Medium” (score \geq 1.5 and < 2.5), and “High” (score \geq 2.5).

The steps include:

Step 1.1

Enter the appropriate segment information into the columns titled “Segment”, “Segment Length”, “Segment Mileposts” and “Facility Type”.

Step 1.2

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2/WP#2 into the appropriate “Performance Score” columns. Copy the performance score for each segment to the appropriate “Performance Score” column. Paste only the “values” and do not overwrite the formatting.

Step 1.3

Indicate if Pavement is an Emphasis Area by selecting “Yes” or “No” in the row immediately below the segment information.

Step 1.4

Confirm that that the Step 1 template is generating the appropriate “Level of Need” for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the segment information and the initial needs from the Step 1 template to the “Initial Need” column of the Step 2 template.

Step 2.2

Note in the “Hot Spots” column any pavement failure hot spots identified as part of the baseline corridor performance. For each entry, include the milepost limits of the hot spot. Hot spots are identified in the Pavement Index spreadsheet by the red cells in the columns titled “% Pavement Failure”. These locations are based on the following criteria:

Interstates: IRI > 105 or Cracking > 15

Non-Interstates: IRI > 142 or Cracking > 15

Every segment that has a % Pavement Failure greater than 0% will have at least one hot spot. Hot spot locations should be described as extending over consecutive miles. For example, if there is a pavement failure location that extends 5 consecutive miles, it should be identified as one hot spot, not 5 separate hot spots.

Step 2.3

Identify recently completed or under construction paving projects in the “Previous Projects” column. Include only projects that were completed after the pavement condition data period (check dates in pavement condition data provided by ADOT) that would supersede the results of the performance system.

Step 2.5

Update the “Final Need” column using the following criteria:

- If “None” but have a hot spot (or hot spots), the Final Need = Low, and note the reason for the change in the “Comments” column (column H).

- If a recent project has superseded the performance rating data, change the Final Need to “None” and note the reason for the change in the “Comments” column.

Example Scales for Level of Need

Performance Thresholds		Initial Need	Description
3.75		None	(>3.57)
3.2		Low	Middle 1/3rd of Fair Perf. (3.38 - 3.57)
		Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance (3.02-3.38)
		High	Lower 2/3rd of Poor Performance (<3.02)

Need Scale for Interstates

Measure	None >=	Low >=	> Medium <		High <=
Pavement Index (corridor non-emphasis area)	3.57	3.38	3.38	3.02	3.02
Pavement Index (corridor emphasis area)	3.93	3.57	3.57	3.20	3.20
Pavement Index (segments)	3.57	3.38	3.38	3.02	3.02
Directional PSR	3.57	3.38	3.38	3.02	3.02
%Pavement Failure	10%	15%	15%	25%	25%

Need Scale for Highways (Non-Interstates)

Measure	None >=	Low >=	> Medium <		High <=
Pavement Index (corridor non-emphasis area)	3.30	3.10	3.10	2.70	2.70
Pavement Index (corridor emphasis area)	3.70	3.30	3.30	2.90	2.90
Pavement Index (segments)	3.30	3.10	3.10	2.70	2.70
Directional PSR	3.30	3.10	3.10	2.70	2.70
%Pavement Failure	10%	15%	15%	25%	25%

Step 2.6

Note any programmed projects that could have the potential to mitigate pavement needs in in the “Comments” column. Programmed projects are provided as information and do not impact the need rating. The program information can be found in ADOT’s 5-year construction program. If there are other comments relevant to the needs analysis (such as information from previous reports), they can be entered in the “Comments” column. However, only include information related to needs that have been identified through this process. Do not add or create needs from other sources.

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to complete Step 3 include:

Step 3.1

Input the level of historical investment for each segment. This will be determined from the numeric score from the Pavement History Table based on the following thresholds:

- Low = < 4.60
- Medium = 4.60 – 6.60
- High = > 6.60

If the PeCOS data shows a high level of maintenance investment, increase the historical investment rating by one level.

Step 3.2

Note the milepost ranges of pavement failure hot spots into the column titled “Contributing Factors and Comments.”

Step 3.3

Note any other information that may be contributing to the deficiency, or supplemental information, in the “Contributing Factors and Comments” column. This could come from discussions with ADOT District staff, ADOT Materials/Pavement Group, previous reports, or the historical investment data.

Step 3.4

Include any programmed projects from ADOT’s 5-year construction program in the “Contributing Factors and Comments” column.

Bridge Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Bridge Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate “Performance Score” columns. This includes the primary and secondary measures for Bridge. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of “None” (score = 0), “Low” (score = 1), “Medium” (score = 2), and “High” (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled “Needs Assessment Scales” within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scores, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial level of need for each segment (combining the primary and secondary measures) has levels of “None” (score < 0.01), “Low” (score \geq 0.01 and < 1.5), “Medium” (score \geq 1.5 and < 2.5), and “High” (score \geq 2.5).

The steps include:

Step 1.1

Enter the appropriate segment information into the columns titled “Segment”, “Segment Length”, “Segment Mileposts” and “Number of Bridges”.

Step 1.2

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2/WP#2 into the appropriate “Performance Score” columns. Copy the performance score for each segment to the appropriate “Performance Score” column. Paste only the “values” and do not overwrite the formatting.

Step 1.3

Indicate if Bridge is an Emphasis Area by selecting “Yes” or “No” in the row immediately below the segment information.

Step 1.4

Confirm that the Step 1 template is generating the appropriate “Level of Need” for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial needs from the Step 1 template to the “Initial Need” column of the Step 2 template.

Step 2.2

Note in the column titled “Hot Spots” any bridge hot spots identified as part of the baseline corridor performance. For each entry, note the specific location. Hot spots are identified as having any bridge rating of 4 or less, or multiple ratings of 5 in the deck, substructure, or superstructure ratings.

Step 2.3

Identify recently completed or under construction bridge projects in the “Previous Projects” column. Include only projects that were completed after the bridge condition data period (check dates in bridge condition data provided by ADOT) that would supersede the results of the performance system.

Step 2.4

Update the Final Need on each segment based on the following criteria:

- If the Initial Need is “None” and there is at least one hot spot located on the segment, change the Final Need to “Low”.
- If a recent project has superseded the performance rating data, the performance data should be adjusted to increase the specific ratings and the resulting need should be reduced to account for the project.
- Note the reason for any change in the “Comments” column.

Step 2.5

Historical bridge rating data was tabulated and graphed to find any bridges that had fluctuations in the ratings. Note in the “Historical Review” column any bridge that was identified as having a potential historical rating concern based on the following criteria:

- Ratings increase or decrease (bar chart) more than 2 times
- Sufficiency rating drops more than 20 points

This is for information only and does not affect the level of need.

Step 2.6

Note the number of functionally obsolete bridges in each segment in the column titled “# Functionally Obsolete Bridges”. This is for information only and does not affect the level of need.

Step 2.7

Identify each bridge “of concern” in the “Comments” column. Note any programmed projects that could have the potential to mitigate bridge needs. Programmed projects are provided as information and do not impact the need rating. The program information can be found in ADOT’s 5-year construction program. If there are other comments relevant to the needs analysis (such as information from previous reports), they can be entered in the “Comments” column. However, only include information related to needs that have been identified through this process. Do not add or create needs from other sources.

Example Scales for Level of Need

Bridge Index Performance Thresholds	Level of Need		Description
6.5	Good	None	All of Good Performance and upper 1/3 rd of Fair Performance
	Good		
	Good		
	Fair	Low	Middle 1/3 rd of Fair Performance
5.0	Fair		
	Fair	Medium	Lower 1/3 rd of Fair and top 1/3 rd of Poor Performance
	Poor		
	Poor	High	Lower 2/3 rd of Poor Performance
	Poor		

Need Scale

Measure	None >=	Low >=	> Medium <		High <=
Bridge Index (corridor non-emphasis area)	6.0	5.5	5.5	4.5	4.5
Bridge Index (corridor emphasis area)	7.0	6.0	6.0	5.0	5.0
Bridge Index (segments)	6.0	5.5	5.5	4.5	4.5
Bridge Sufficiency	70	60	60	40	40
Bridge Rating	6.0	5.0	4.0	4.0	3.0
%Functionally Obsolete Bridges	21.0%	31.0%	31.0%	49.0%	49.0%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to complete Step 3 include:

Step 3.1

Input the bridge name, structure number, and milepost information for each bridge “of concern” resulting from Step 2.

Step 3.2

For bridges that have a current rating of 5 or less, enter the specific rating, or state “No current ratings less than 6”.

Step 3.3

For bridges that were identified for a historical review (step 2.5), state “Could have a repetitive investment issue”. If a bridge was not identified for a historical review, state “This structure was not identified in historical review”.

Step 3.4

Input any programmed projects from ADOT’s 5-year construction program. Note any other information that may be contributing to the deficiency, or supplemental information. This could come from discussions with ADOT District staff, ADOT Bridge Group, or previous reports.

Mobility Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Mobility Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Refined Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate “Performance Score” columns from Task 2/Working Paper #2. This includes the primary and secondary measures for Mobility. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of “None” (score = 0), “Low” (score = 1), “Medium” (score = 2), and “High” (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled “Needs Assessment Scales” in the Step 1 tab.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scores, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of “None” (score < 0.01), “Low” (score \geq 0.01 and < 1.5), “Medium” (score \geq 1.5 and < 2.5), and “High” (score \geq 2.5).

The steps include:

Step 1.1

Input the accurate number of segments for your corridor in the column titled ‘Segment’ and the appropriate segment milepost limits and segment lengths in adjacent columns.

Step 1.2

Select the appropriate ‘Environment Type’ and ‘Facility Operation Type’ from the drop down menus as defined in Task 2 - Existing Performance Analysis.

Step 1.3

Select ‘Yes’ or ‘No’ from the drop down list to not if the Mobility Performance Area is an Emphasis Area for your corridor.

Step 1.4

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2/Working Paper #2. Copy the performance score for each segment to the appropriate “Performance Score” column.

Step 1.5

Confirm that that the Step 1 template is generating the appropriate “Level of Need” for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2 The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial deficiencies from the Step 1 template to the Step 2 template.

Step 2.2

Identify recently completed or under construction projects that would be considered relevant to mobility performance. Include only projects that were constructed after 2014 for which the 2014 HPMS data used for traffic volumes would not include. Any completed or under construction roadway project after 2014 that has the potential to mitigate a mobility issue on a corridor segment should be listed in the template. Such projects should include the construction of new travel lanes or speed limit changes on the main corridor only. Do not include projects involving frontage roads or crossings as they would not impact the corridor level performance.

Step 2.3

Update the Final Need using the following criteria:

- If a recent project has superseded the performance rating data and it is certain the project addressed the deficiency, change the need rating to “None”.
- If a recent project has superseded the performance rating data but it is uncertain that a project addressed the need, maintain the current deficiency rating and note the uncertainty as a comment.

Step 2.4

Note any programmed or planned projects that have the potential to mitigate any mobility need on the segment. Programmed and Planned projects are provided as information and do not impact the deficiency rating. Future projects will be reviewed in the development of solution sets for identified needs and deficiencies. The source of future projects can be found in ADOT’s 5-year construction program or other planning documents. Other comments relevant to the needs analysis can be entered.

Example Scales for Level of Need

Performance Thresholds	Initial Need		Description
0.71		None	(<0.77)
0.89		Low	Middle 1/3rd of Fair Perf. (0.77 - 0.83)
		Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance (0.83-0.95)
		High	Lower 2/3rd of Poor Performance (>0.95)

Needs Scale

Measure		None <=	Low >=	> Medium <		High <=
Mobility Index (Corridor Emphasis Area)		Weighted calculation for the segment totals in corridor (urban vs. rural)				
Mobility Index (Corridor Non-Emphasis Area)		Weighted calculation for the segment totals in corridor (urban vs. rural)				
Mobility Index (Segment)	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Future Daily V/C	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Existing Peak hour V/C	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Closure Extent		0.35	0.49	0.49	0.75	0.75
Directional TTI	Uninterrupted	1.21	1.27	1.27	1.39	1.39
	Interrupted	1.53	1.77	1.77	2.23	2.23
Directional PTI	Uninterrupted	1.37	1.43	1.43	1.57	1.57
	Interrupted	4.00	5.00	5.00	7.00	7.00
Bicycle Accommodation		80%	70%	70%	50%	50%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to complete Step 3 include:

Step 3.1

Input data from Mobility Index worksheet and corridor observations in appropriate columns for Roadway Variables.

Step 3.2

Input traffic variable data in appropriate columns as indicated, Buffer Index scores will auto populate.

Step 3.3

Input relevant mobility related infrastructure located within each segment as appropriate

Step 3.4

Input the Closure Extents that have occurred along the study corridor. Road closure information can be detailed out by the reason for the closure as documented in Highway Condition Reporting System (HCRS) data analyzed as part of the baseline corridor performance. Closure reasons include incident/accidents, winter storms, obstruction hazards, and undefined closures. Statewide average percentages for the various closure reasons have been calculated for 2009-2013 on ADOT’s 11 designated strategic corridors. Compare these statewide average percentages to the corridor percentages for the various closure reasons to identify higher than average percentages of one or more closure reasons on any given segment. Input the closures as follows and use red text to indicate that the segment percentage exceeds statewide averages:

- Total Number of Closures
- % Incidents/Accidents
- % Obstructions/Hazards
- % Weather Related

Step 3.5

List the non-actionable conditions that are present within each segment by milepost if possible. Non-Actionable conditions are conditions that exist within the environment of each segment that cannot be improved through an engineered solution. For example, the border patrol check point in Segment 3 of I-19 is a non-actionable condition.

Step 3.6

Considering all information input, identify and list the contributing factors to the Final Need score.

Safety Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Safety Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the corridor characteristics and existing performance score for each segment to the appropriate “Performance Score” columns. This includes the primary and secondary measures for safety. As each performance score is input into the template, the Level of Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of “None” (score = 0), “Low” (score = 1), “Medium” (score = 2), and “High” (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled “Needs Scale” within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scores, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of “None” (score < 0.01), “Low” (score ≥ 0.01 and < 1.5), “Medium” (score ≥ 1.5 and < 2.5), and “High” (score ≥ 2.5).

The steps include:

Step 1.1

Populate the Step 1 template with the corridor characteristics information. This includes segment operating environments and segment length. Also specify if the safety performance area is an emphasis area as determined in Task 3. The “Level of Need” is dependent on the input of the operating environment and “Emphasis Area” as the thresholds dynamically update accordingly.

Input the existing (baseline) performance scores for all primary and secondary performance measures from Task 2. Copy the performance score (paste values only) for each segment to the appropriate “Performance Score” column and conditional formatting should color each cell green, yellow, or red based on the corresponding performance thresholds.

Step 1.2

The thresholds for the corridor safety index are based on the segments’ operating environments. To ensure that the correct corridor safety index threshold are applied, input the unique segment operating environments that exist with the corridor. Once the input is complete, the average of the Good/Fair and Fair/Poor thresholds for each of the operating environments is calculated and the “Level of Need” thresholds will be derived and applied to the main Step 1 Table.

Step 1.3

Confirm that the following criteria for “Insufficient Data” has been applied and that the resulting Level of Need has been shown as “N/A” where applicable.

- Crash frequency for a segment is less than 5 crashes over the 5-year crash analysis period.
- The change in +/- 1 crash results in the change of need level of 2 levels (i.e., changes from Good to Poor or changes from Poor to Good).
- The average segment crash frequency for the overall corridor (total fatal plus incapacitating injury crash frequency divided by the number of corridor segments) is less than 2 per segment over the 5-year crash analysis period.

Step 1.4

Confirm that the Step 1 template is generating the appropriate “Level of Need” for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial needs from the Step 1 template to the Step 2 template.

Step 2.2

Using the crash concentration (hot spot) map developed as part of the baseline corridor performance, note the direction of travel and approximate milepost limits of each hot spot.

Step 2.3

Identify recently completed or under construction projects that would be considered relevant to safety performance. Include only projects that were not taken into account during the crash data analysis period (2009 – 2013). Any completed or under construction roadway project after 2013 that has the potential to mitigate a safety issue on a corridor segment should be listed in the

template. Sources of recent or current project activity can include ADOT MPD staff, ADOT public notices, and ADOT District staff.

Step 2.4

Update the Final Need based on the following criteria:

- If there is a crash hot spot concentration on a “None” segment, upgrade the need rating to “Low”.

Step 2.5

Note any programmed projects that could have the potential to mitigate any safety need on the segment. Programmed projects are provided as information and do not impact the need rating. Programmed projects will be reviewed in the development of solution sets for identified needs. The source of the programming information can be found in ADOT’s 5-year construction program. Any other relevant issues identified in previous reports should also be reported.

Needs Scale

Measure		None <=	Low <=	< Medium >		High >=	Good/Fair Threshold	Fair/Poor Threshold	
Corridor Safety Index (Emphasis Area)		Weighted average based on operating environment type							
Corridor Safety Index (Non-Emphasis Area)		# Weighted average based on operating environment type						#DIV/0!	#DIV/0!
Safety Index and Directional Safety Index (Segment)	2 or 3 Lane Undivided Highway	0.98	1.02	1.02	1.10	1.10	0.94	1.06	
	2 or 3 or 4 Lane Divided Highway	0.92	1.07	1.07	1.38	1.38	0.77	1.23	
	4 or 5 Lane Undivided Highway	0.93	1.06	1.06	1.33	1.33	0.8	1.2	
	6 Lane Highway	0.85	1.14	1.14	1.73	1.73	0.56	1.44	
	Rural 4 Lane Freeway with Daily Volume < 25,000	0.91	1.09	1.09	1.45	1.45	0.73	1.27	
	Rural 4 Lane Freeway with Daily Volume > 25,000	0.89	1.1	1.1	1.53	1.53	0.68	1.32	
	Urban 4 Lane Freeway	0.93	1.07	1.07	1.35	1.35	0.79	1.21	
	Urban or Rural 6 Lane Freeway	0.94	1.06	1.06	1.3	1.3	0.82	1.18	
	Urban > 6 Lane Freeway	0.93	1.06	1.06	1.33	1.33	0.8	1.2	
% of Fatal + Incap. Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	2 or 3 Lane Undivided Highway	53%	55%	55%	59%	59%	51%	57%	
	2 or 3 or 4 Lane Divided Highway	47%	50%	50%	57%	57%	44%	54%	
	4 or 5 Lane Undivided Highway	45%	48%	48%	54%	54%	42%	51%	
	6 Lane Highway	39%	43%	43%	50%	50%	35%	46%	
	Rural 4 Lane Freeway with Daily Volume < 25,000	46%	49%	49%	56%	56%	43%	53%	
	Rural 4 Lane Freeway with Daily Volume > 25,000	46%	51%	51%	62%	62%	41%	57%	
	Urban 4 Lane Freeway	52%	55%	55%	62%	62%	49%	59%	
	Urban or Rural 6 Lane Freeway	42%	50%	50%	65%	65%	34%	57%	
	Urban > 6 Lane Freeway	47%	51%	51%	59%	59%	43%	55%	
% of Fatal + Incap. Injury Crashes Involving Trucks	2 or 3 Lane Undivided Highway	6%	7%	7%	8%	8%	5%	7%	
	2 or 3 or 4 Lane Divided Highway	5%	6%	6%	8%	8%	4%	7%	
	4 or 5 Lane Undivided Highway	7%	8%	8%	11%	11%	6%	10%	
	6 Lane Highway	3%	6%	6%	12%	12%	0%	9%	
	Rural 4 Lane Freeway with Daily Volume < 25,000	14%	15%	15%	18%	18%	13%	17%	
	Rural 4 Lane Freeway with Daily Volume > 25,000	9%	11%	11%	15%	15%	7%	13%	
	Urban 4 Lane Freeway	8%	9%	9%	12%	12%	7%	11%	
	Urban or Rural 6 Lane Freeway	8%	10%	10%	13%	13%	6%	11%	
	Urban > 6 Lane Freeway	4%	5%	5%	7%	7%	3%	6%	
% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	2 or 3 Lane Undivided Highway	22%	25%	25%	30%	30%	19%	27%	
	2 or 3 or 4 Lane Divided Highway	19%	22%	22%	29%	29%	16%	26%	
	4 or 5 Lane Undivided Highway	7%	8%	8%	10%	10%	6%	9%	
	6 Lane Highway	7%	14%	14%	27%	27%	0%	20%	
	Rural 4 Lane Freeway with Daily Volume < 25,000	6%	7%	7%	9%	9%	5%	8%	
	Rural 4 Lane Freeway with Daily Volume > 25,000	11%	14%	14%	20%	20%	8%	17%	
	Urban 4 Lane Freeway	10%	11%	11%	13%	13%	9%	12%	
	Urban or Rural 6 Lane Freeway	9%	11%	11%	15%	15%	7%	13%	
	Urban > 6 Lane Freeway	15%	17%	17%	22%	22%	13%	20%	
% of Fatal _ Incapacitating Injury Crashes Involving Non-Motorized	2 or 3 Lane Undivided Highway	3%	4%	4%	5%	5%	2%	4%	
	2 or 3 or 4 Lane Divided Highway	3%	4%	4%	5%	5%	2%	4%	
	4 or 5 Lane Undivided Highway	6%	7%	7%	9%	9%	5%	8%	
	6 Lane Highway	11%	14%	14%	20%	20%	8%	17%	
	Rural 4 Lane Freeway with Daily Volume < 25,000	2%	2%	2%	3%	3%	1.7%	2.5%	

Travelers	Rural 4 Lane Freeway with Daily Volume > 25,000	0%	0%	0%	0%	0%	0%	0%
	Urban 4 Lane Freeway	7%	9%	9%	12%	12%	5%	10%
	Urban or Rural 6 Lane Freeway	3%	5%	5%	9%	9%	1%	7%
	Urban > 6 Lane Freeway	1%	1%	1%	2%	2%	0.5%	1.5%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab.

Table 3 - Step 3 Template

A separate *Crash Summary Sheet* file contains summaries for 8 crash attributes for the entire corridor, for each corridor segment, and for statewide roadways with similar operating environments (the database of crashes on roadways with similar operating environments was developed in Task 2 (the baseline corridor performance)). The crash attribute summaries are consistent with the annual ADOT Publication, *Crash Facts*. The 8 crash attribute summaries consist of the following:

- First Harmful Event (FHET)
- Crash Type (CT)
- Violation or Behavior (VB)
- Lighting Condition (LC)
- Roadway Surface Type (RST)
- First Unit Event (FUE)
- Driver Physical Condition (Impairment)
- Safety Device Usage (Safety Device)

Non-colored tabs in this spreadsheet auto-populate with filtered crash attributes. Each tab is described below:

- **Step_3_Summary** – This tab contains the filtered summary of crashes that exceed statewide thresholds for crashes on roadways with similar operating environments. Data in this tab are copied into the Step 3 template.
- **Statewide** – This tab contains a summary of statewide crashes from roadways with similar operating environments filtered by the 8 crash type summaries listed above. The crash type summaries calculate statewide crash thresholds (% total for fatal plus incapacitating crashes). The crash thresholds were developed to provide a statewide expected proportion of crash attributes against which the corridor segments’ crash attributes can be compared. The crash thresholds were developed using the *Probability of Specific Crash Types Exceeding a Threshold Proportion* as shown in the Highway Safety Manual, Volume 1 (2010). The thresholds are automatically calculated within the spreadsheet. The threshold proportion was calculated as follows:

$$p * _i = \frac{\sum N_{Observed,i}}{\sum N_{Observed,i(total)}}$$

Where:

- $p * _i$ = Threshold proportion
- $\sum N_{Observed,i}$ = Sum of observed target crash frequency within the population
- $\sum N_{Observed,i(total)}$ = Sum of total observed crash frequency within the population

A minimum crash sample size of 5 crashes over the 5-year crash analysis period is required for a threshold exceedance to be displayed in the Step 3 template. The probability of exceeding the crash threshold was not calculated to simplify the process.

- **Corridor** – A summary of corridor-wide crashes filtered by the 8 crash attribute summaries listed above.
- **Segment FHET** – A segment-by-segment summary of crashes filtered by first harmful event attributes.
- **Segment CT** – A segment-by-segment summary of crashes filtered by crash type attributes.
- **Segment VB** - A segment-by-segment summary of crashes filtered by violation or behavior attributes.
- **Segment LC** – A segment-by-segment summary of crashes filtered by lighting condition attributes.
- **Segment RST** – A segment-by-segment summary of crashes filtered by roadway surface attributes.
- **Segment FUE** – A segment-by-segment summary of crashes filtered by first unit event attributes.
- **Segment Impairment** – A segment-by-segment summary of crashes filtered by driver physical condition attributes related to impairment.
- **Segment Safety Device** – A segment-by-segment summary of crashes filtered by safety device usage attributes.

The steps to compete Step 3 include:

Step 3.1

Using the Crash_Summary_Sheet.xlsx, go to the “Step_3_Summary” tab. Input the operating environments for each segment in the table.

Step 3.2

Filter data from the ADOT database for the “CORRIDOR_DATA” tab by inserting the following data in the appropriate columns that are highlighted in gray for the “INPUT_CORRIDOR_DATA” tab:

- Incident ID
- Incident Crossing Feature (MP)
- Segment Number (Non-native ADOT data – must be manually assigned based on the location of the crash)
- Operating Environment (Non-native ADOT data – should already be assigned but if for some reason it isn’t, it will need to be manually assigned)
- Incident Injury Severity
- Incident First Harmful Description
- Incident Collision Manner
- Incident Lighting Condition Description
- Unit Body Style
- Surface Condition
- First Unit Event Sequence
- Person Safety Equipment
- Personal Violation or Behavior
- Impairment

Note that columns highlighted in yellow perform a calculated input to aggregate specific crash descriptions. For example, crashes can contain various attributes for animal-involved crashes. The crash attributes that involve an animal were combined into a common attribute, such as “ANIMAL”. This will allow the summaries to be consistent with the ADOT *Crash Facts*.

The data in the Impairment category contains blank descriptions if it was found that there was “No Apparent Influence” or if it was “Unknown”. Using the crash data fields “PersonPhysicalDescription” 0 - 99, fill in the blank columns to reflect if the physical description is described as “No Apparent Influence” or “Unknown”. Note that the native physical description data from the ADOT database may need to be combined to a single column.

Step 3.3

Confirm that the crash database is being properly filtered by comparing crash frequencies from the summary tables with the frequencies developed in Task 2. For example, the lookup function will fail if the filter is for “NO IMPROPER ACTION” if the database has the attribute of “NO_IMPROPER_ACTION”.

Step 3.4

Copy and paste the Step_3_Summary into the Task 4 – Safety Needs Assessment spreadsheet in the Step 3 tab. Paste values only and remove the summaries with “0%s” for a clean display. Where duplicate values exist, go to the “Calcs” tab in the Crash_Summary_Sheet file to determine which categories have the same %. If there are more crash types with the same % than there is space in the table, select the crash type with the highest difference between the segment % and the statewide average %

Step 3.5

The Step 3 table in the Task 4 – Safety Needs Assessment spreadsheet should be similar to the Step 3 template. In the Segment Crash Summaries row, the top three crash attributes are displayed. Change the font color of the crash attributes that exceed the statewide crash threshold to red for emphasis. The attributes with a red font in the “Calcs” tab have exceeded statewide crash thresholds. Note that corridor-wide values are not compared to statewide values as corridor-wide values are typically a blend of multiple similar operating environments while the statewide values apply to one specific similar operating environment.

Step 3.6

Provide a summary of any observable patterns found within the crash Hot Spots, if any exist in the segments.

Step 3.7

Input any historic projects (going no further back than 2000) that can be related to improving safety. Projects more than five years old may have exceeded their respective design life and could be contributing factors to safety performance needs.

Step 3.8

Input key points from District interviews or any important information from past discussions with District staff that is consistent with needs and crash patterns identified as part of the performance and needs assessment as this may be useful in identifying contributing causes. This information may be obtained from District Maintenance personnel by requesting the mile post locations that may be considered safety issues.

Step 3.9

For segments with one or more of the following characteristics, review crashes of all severity levels (not just fatal and incapacitating injury crashes). Identify likely contributing factors and compare that to the above statewide average comparison findings already calculated for fatal and incapacitating injury crashes. Refine the contributing factors list accordingly.

- Segments with Medium or High need
- Segments with a crash hot spot concentration (but only review crashes at the concentration areas)
- Segments with no apparent predominant contributing factors based on the comparison of fatal and incapacitating crashes to statewide averages if the segment has a Medium or High need.

Step 3.10

Considering all information in Steps 1-3, list the contributing factors using engineering judgment and the information on contributing factors available in Section 6.2 of the 2010 Highway Safety Manual. Additional sources for determining contributing factors may include aerial, “streetview”, and/or ADOT photologs. Other documents such as Design Concept

Reports (DCR) or Road Safety Assessments can provide insight into the study corridor's contributing factors.

Add comments as needed on additional information related to contributing factors that may have been provided by input from ADOT staff.

Freight Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Freight Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score and color for each segment to the appropriate “Performance Score” columns. This includes the primary and secondary measures for Freight. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of “None” (score = 0), “Low” (score = 1), “Medium” (score = 2), and “High” (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled “Needs Assessment Scale” within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted score, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of “None” (score < 0.01), “Low” (score ≥ 0.01 and < 1.5), “Medium” (score ≥ 1.5 and < 2.5), and “High” (score ≥ 2.5).

The steps include:

Step 1.1

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2. Copy the performance score for each segment to the appropriate “Performance Score” column. Select the *Facility Operations* for each segment from the drop-down list and input whether or not the performance area is an emphasis area. The corridor needs assessment scales will be updated automatically.

Step 1.2

Confirm that that the Step 1 template is generating the appropriate “Level of Need” for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial need from the Step 1 template to the Step 2 template.

Step 2.2

Note any truck height restriction hot spots (clearance < 16') identified as part of the baseline corridor performance. For each entry, note the milepost of the height restriction and if the height restriction can be detoured by ramping around the obstruction. If it is not possible for a truck to ramp around the height restriction, note the existing height as well.

Step 2.3

Identify recently completed or under construction projects that would be considered relevant to freight performance. Include only projects that were not taken into account during the freight data analysis period. Any completed or under construction roadway project after the date of the data that has the potential to mitigate a freight issue on a corridor segment should be listed in the template. Such projects can include the construction of climbing lanes or Dynamic Message Signs (DMS) installation. Sources of recent or current project activity can be ADOT MPD staff, ADOT public notices, and ADOT District staff.

Step 2.4

Update the Final Need using the following criteria:

- If there is one or more truck height restriction hot spots where a truck cannot ramp around on a ‘None’ segment, increase (i.e., worsen) the need rating to ‘Low’.
- If a recent project has superseded the performance rating data and it is certain the project addressed the need, change the need rating to “None”.
- If a recent project has superseded the performance rating data but it is uncertain that a project addressed the need, maintain the current need rating and note the uncertainty as a comment.

Step 2.5

Note any programmed projects that could have the potential to mitigate any freight need on the segment. Programmed projects are provided as information and do not impact the need rating. Programmed projects will be reviewed in the development of solution sets for identified needs. The source of the programming information can be found in ADOT’s 5-year construction program. If there are other comments relevant to the needs analysis, they can be entered in the right-most column.

Example Scales for Level of Need - Freight Index

Performance Score Thresholds	Performance Level	Initial Performance Level of Need	Description (Non-emphasis Area)
	Good	None	All levels of Good and the top third of Fair (>0.74)
	Good		
0.77	Good		
0.74	Fair	Low	Middle third of Fair (0.70-0.74)
0.70	Fair		
0.67	Fair	Medium	Lower third of Fair and top third of Poor (0.64-0.70)
0.64	Poor		
	Poor	High	Lower two-thirds of Poor (<0.64)
	Poor		

Needs Scale

Measure	None >=	> Low <		> Medium <		High <=
Corridor Freight Index (Emphasis Area)	Dependent on weighted average of interrupted vs. uninterrupted segments					
Corridor Freight Index (Non-Emphasis Area)	Dependent on weighted average of interrupted vs. uninterrupted segments					
Freight Index (Segment)						
Measure	None >=	> Low <		> Medium <		High <=
Interrupted	0.28	0.28	0.22	0.22	0.12	0.12
Uninterrupted	0.74	0.74	0.70	0.70	0.64	0.64
Measure	None <=	< Low >		< Medium >		High >=
Directional TTI						
Interrupted	1.53	1.53	1.77	1.77	2.23	2.23
Uninterrupted	1.21	1.21	1.27	1.27	1.39	1.39
Directional PTI						
Interrupted	4.00	4.00	5.00	5.00	7.00	7.00
Uninterrupted	1.37	1.367	1.43	1.43	1.57	1.57
Closure Duration						
All Facility Operations	71.07	71.07	97.97	97.97	151.75	151.75
Measure	None >=	> Low <		> Medium <		High <=
Bridge Clearance (feet)						
All Bridges	16.33	16.33	16.17	16.17	15.83	15.83

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab.

The steps to complete Step 3 include:

Step 3.1

Input all roadway variable data that describe each segment into the appropriate columns. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4.

Step 3.2

Input all traffic variables for each segment into the appropriate columns. The Buffer Index will auto populate based on the TPTI and TTTI input in the Step 1 tab. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4.

Step 3.3

Input any freight-related infrastructure that currently exists on the corridor for each segment. The relevant infrastructure can include DMS locations, weigh stations, Ports of Entry (POE), rest areas, parking areas, and climbing lanes. Include the mileposts of the listed infrastructure. This data can be extracted from the most recent Highway Log and the 2015 Climbing and Passing Lane Prioritization Study.

Step 3.4

Input the Closure Extents that have occurred along the study corridor. Road closure information can be detailed out by the reason for the closure as documented in Highway Condition Reporting System (HCRS) data analyzed as part of the baseline corridor performance. Closure reasons include incident/accidents, winter storms, obstruction hazards, and undefined closures. Statewide average percentages for the various closure reasons have been calculated for the analysis period on ADOT's 11 designated strategic corridors. Compare these statewide average percentages to the corridor percentages for the various closure reasons to identify higher than average percentages of one or more closure reasons on any given segment. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4. Input the closures as follows and use red text to indicate that the segment percentage exceeds statewide averages:

- Total Number of Closures
- % Closures (No Reason)
- % Incidents/Accidents
- % Obstructions/Hazards
- % Weather Related

Step 3.5

List the non-actionable conditions that are present within each segment by milepost if possible. Non-Actionable conditions are conditions that exist within the environment of each segment that cannot be improved through an engineered solution. Examples of Non-Actionable conditions can

include border patrol check points and other closures/restrictions not controlled by ADOT. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4.

Step 3.6

Input any programmed and planned projects or issues that have been identified from previous documents or studies that are relevant to the Final Need. Sources for this data include the current Highway Log, the 2015 Climbing and Passing Lane Prioritization Study, and ADOT's 5-year construction program.

Step 3.7

Considering all information in Steps 1-3, identify the contributing factors to the Final Need column. Potential contributing factors to freight performance needs include roadway vertical grade, number of lanes, traffic volume-to-capacity ratios, presence/lack of a climbing lanes, and road closures. Also identify higher than average percentages of one or more closure reasons on any given segment